Iminosugars: effects of stereochemistry, ring size and *N*-substituents on glucosidase activities

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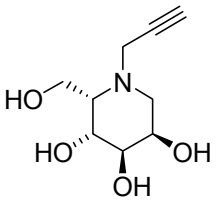
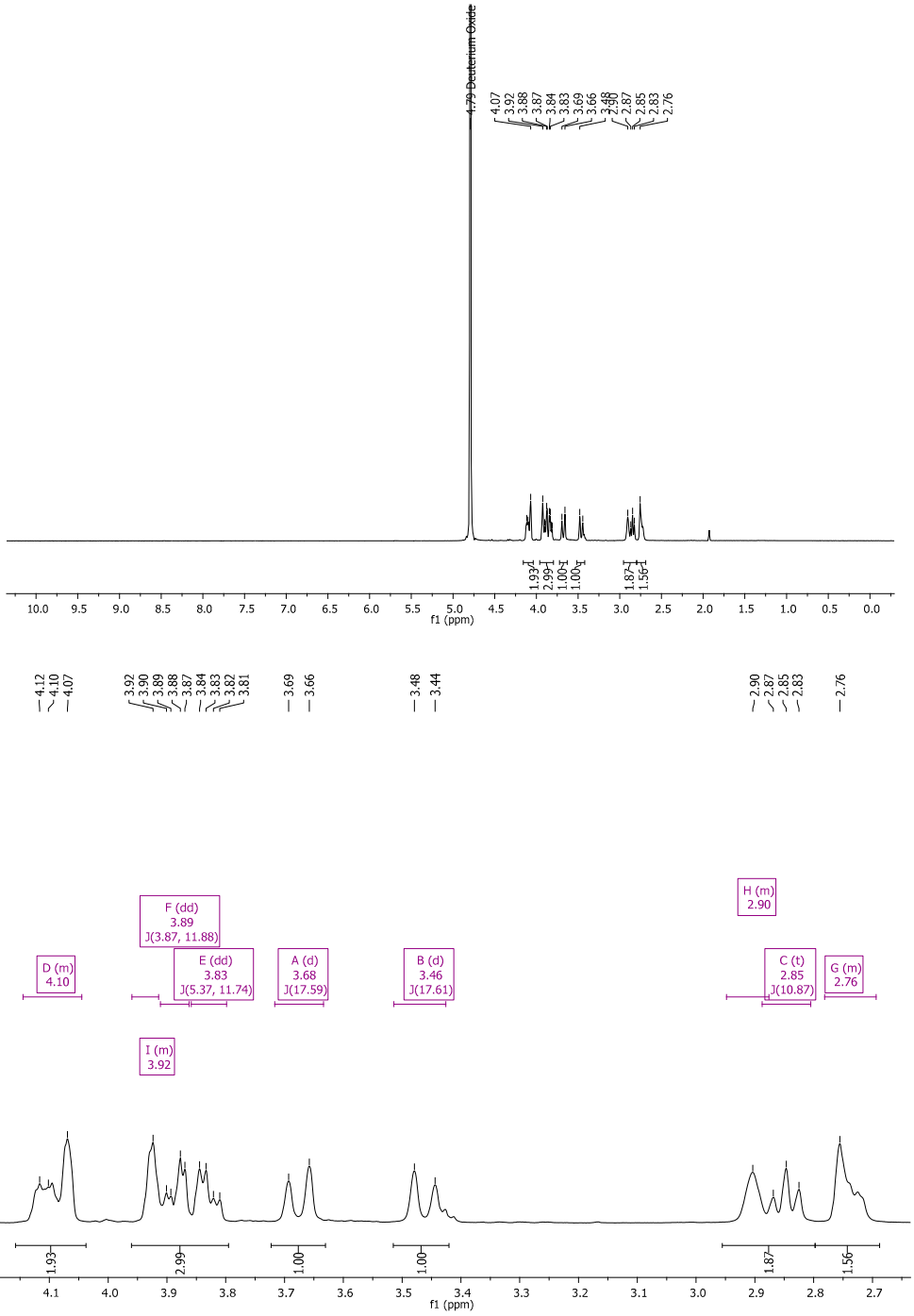
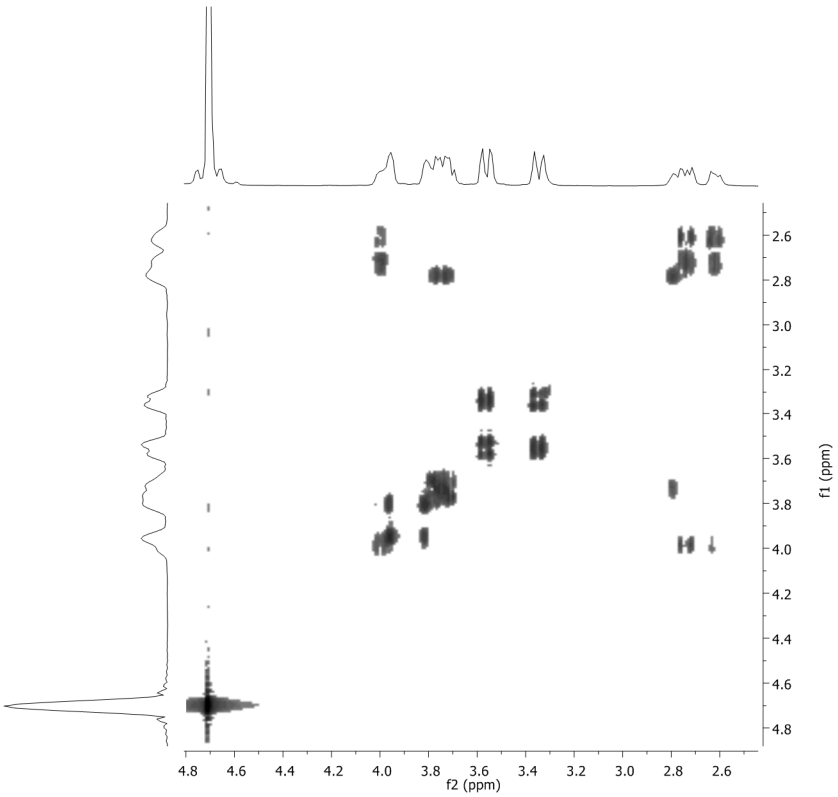
_N_-Propynyl-1,5-dideoxy-1,5-imino-L-gulitol (26a):

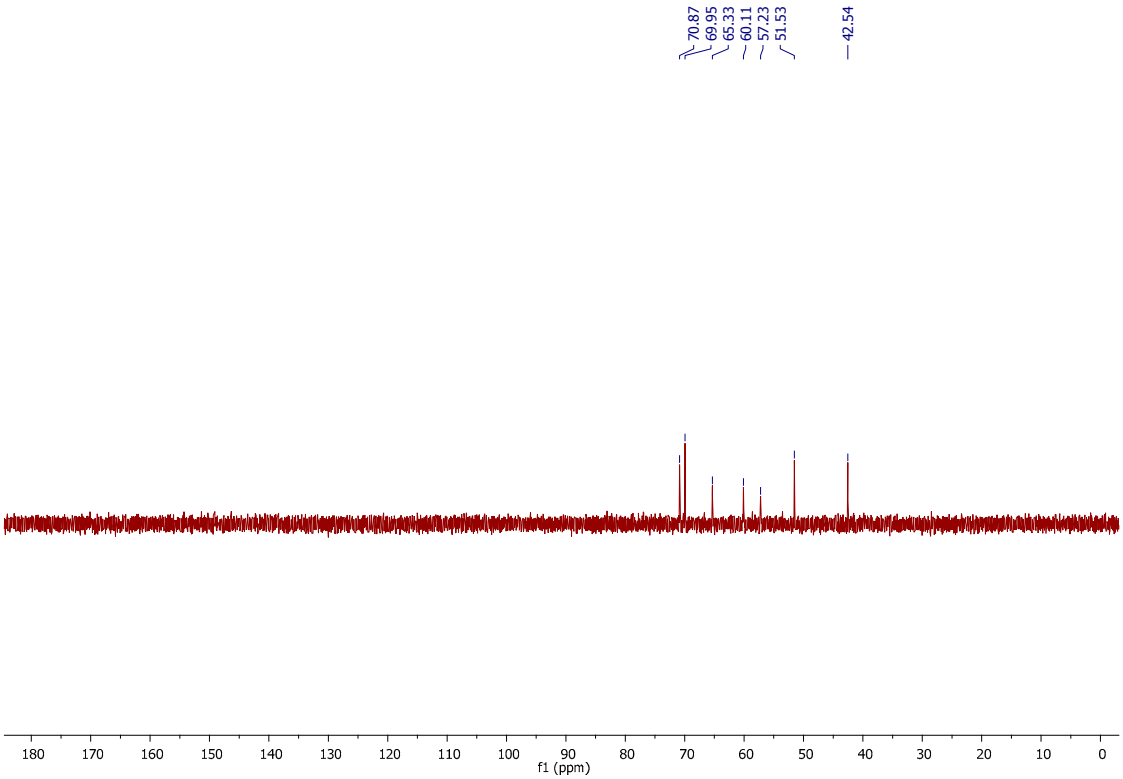




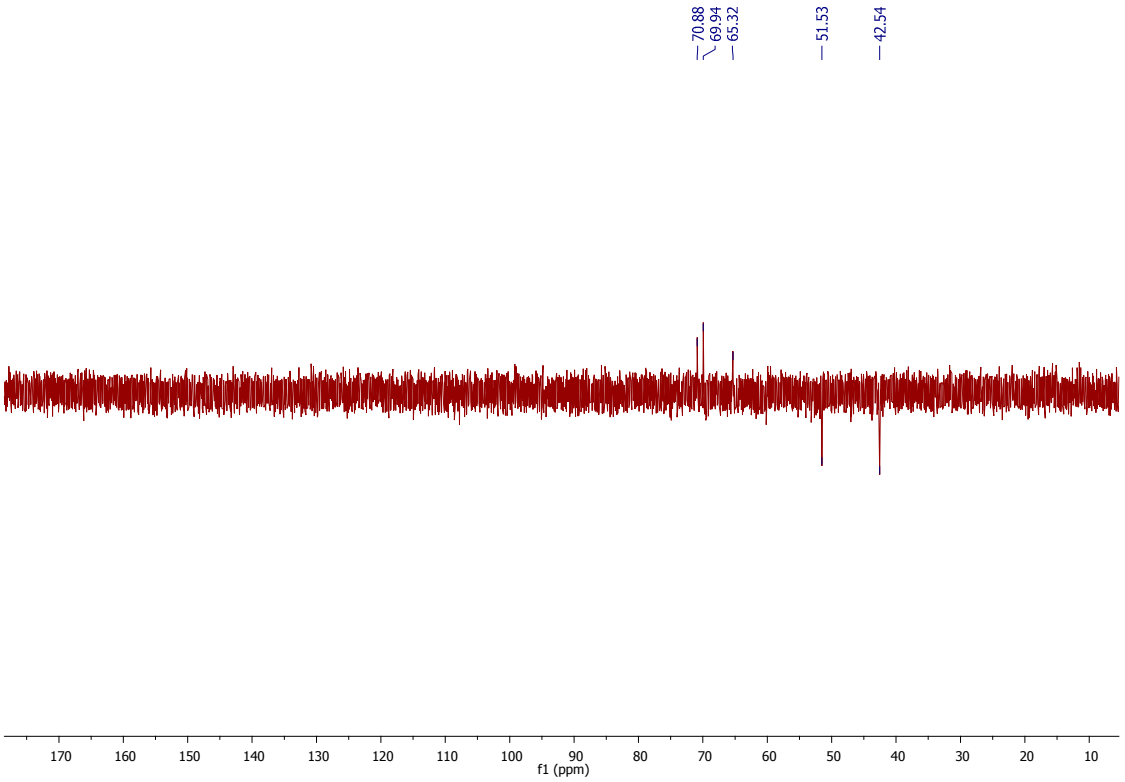
^{1}H NMR (500 MHz, D_2O)



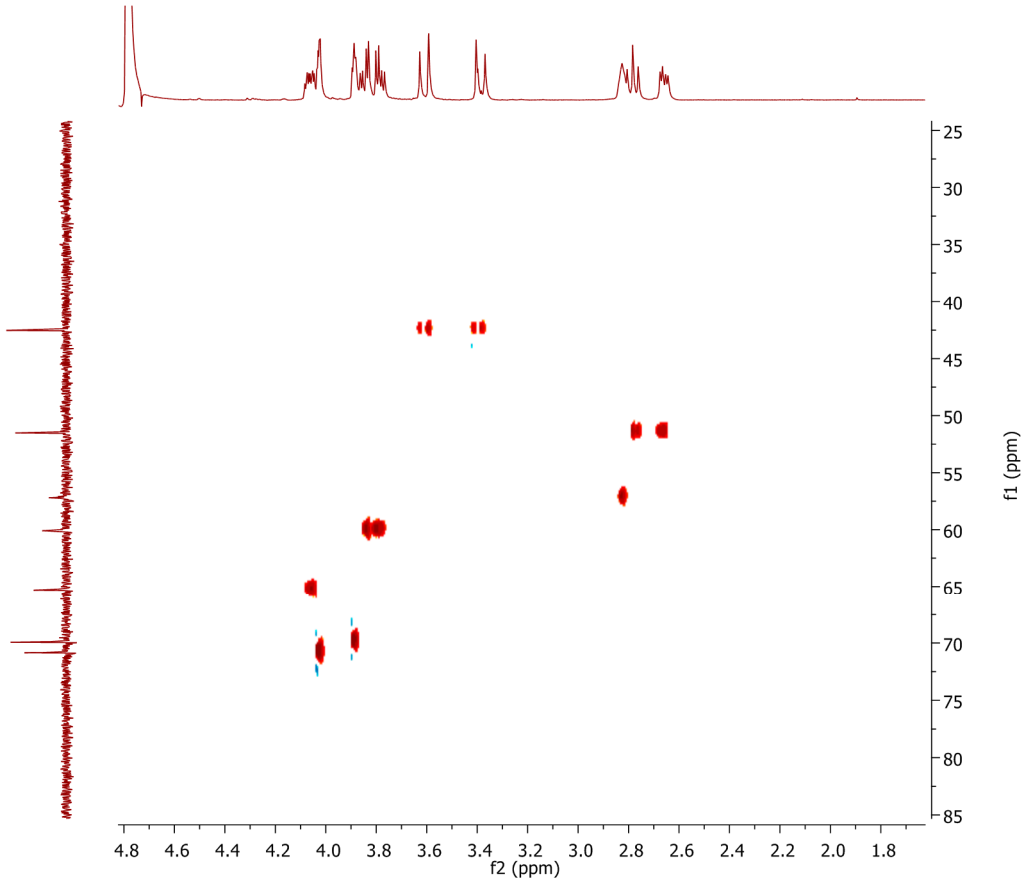
COSY NMR



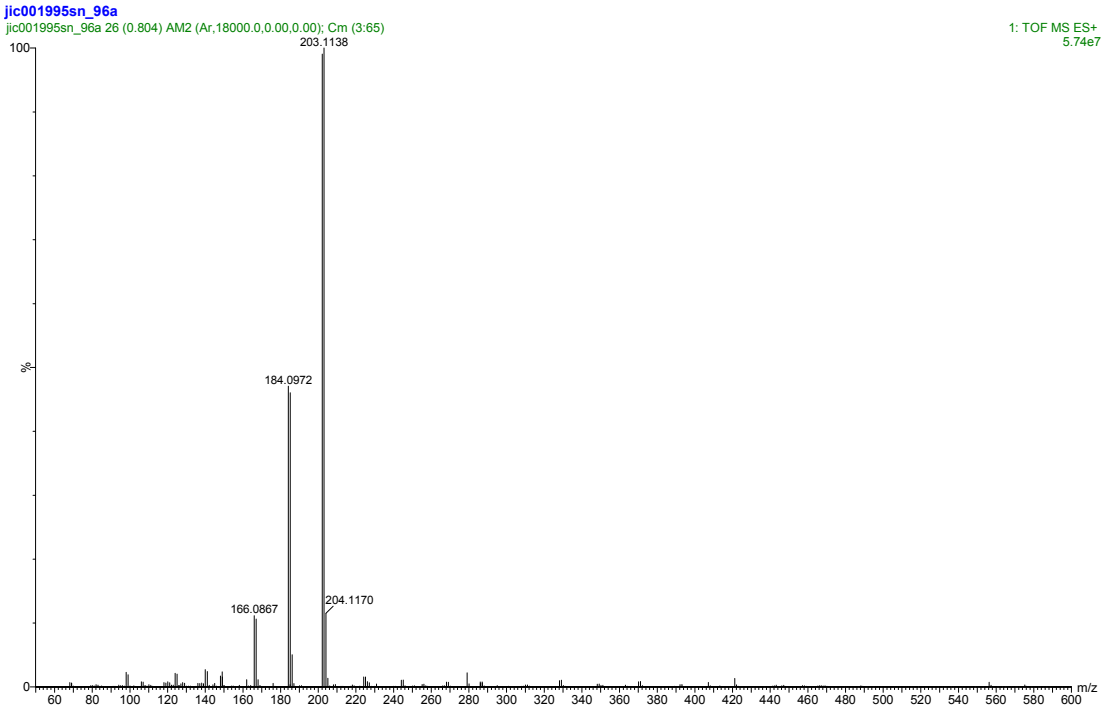
^{13}C NMR (125 MHz, D_2O)



^{13}C NMR DEPT (125 MHz, D_2O)

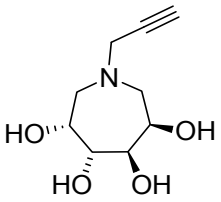


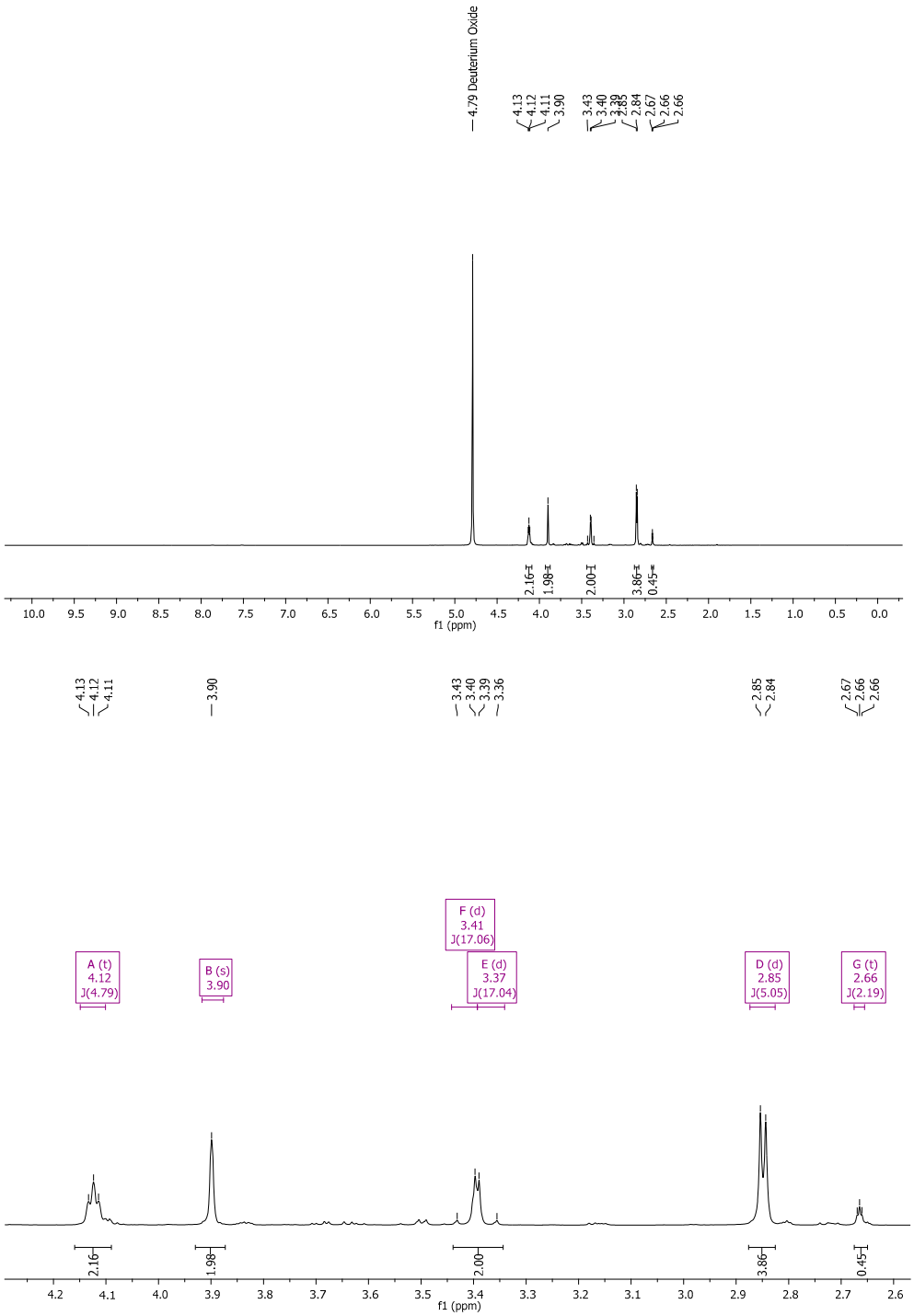
HMQC NMR



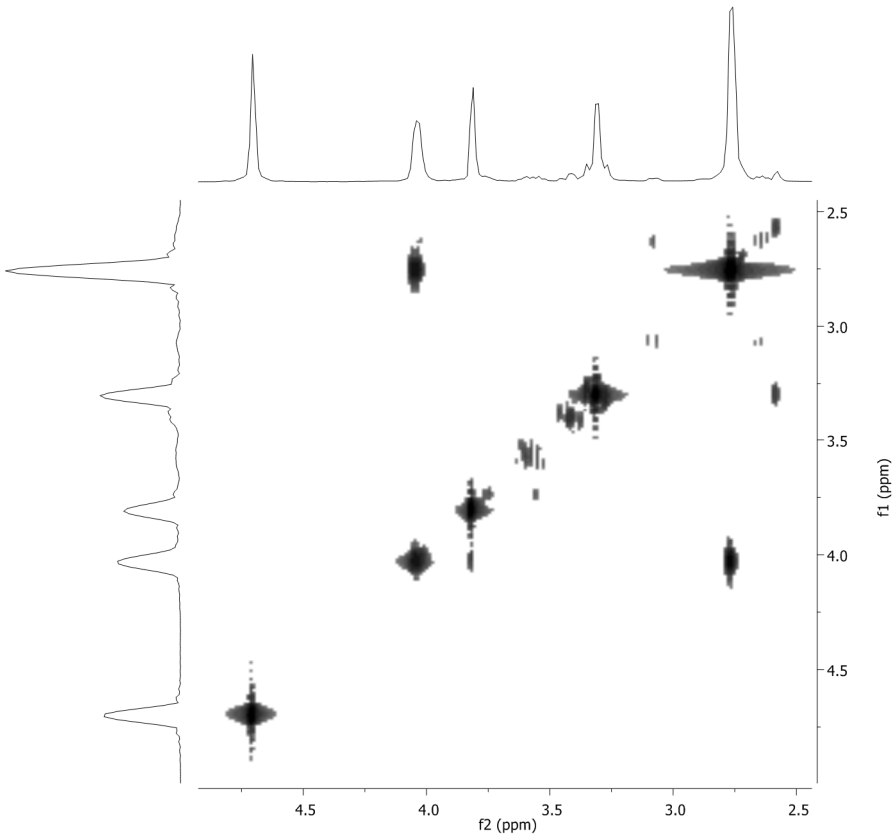
ESI HRMS: $[M+H]^+$ calcd for $C_9H_{15}NO_4$ 202.1074; found 202.1076.

_N_-Propynyl-1,6-dideoxy-1,6-imino-D-mannitol (26b):

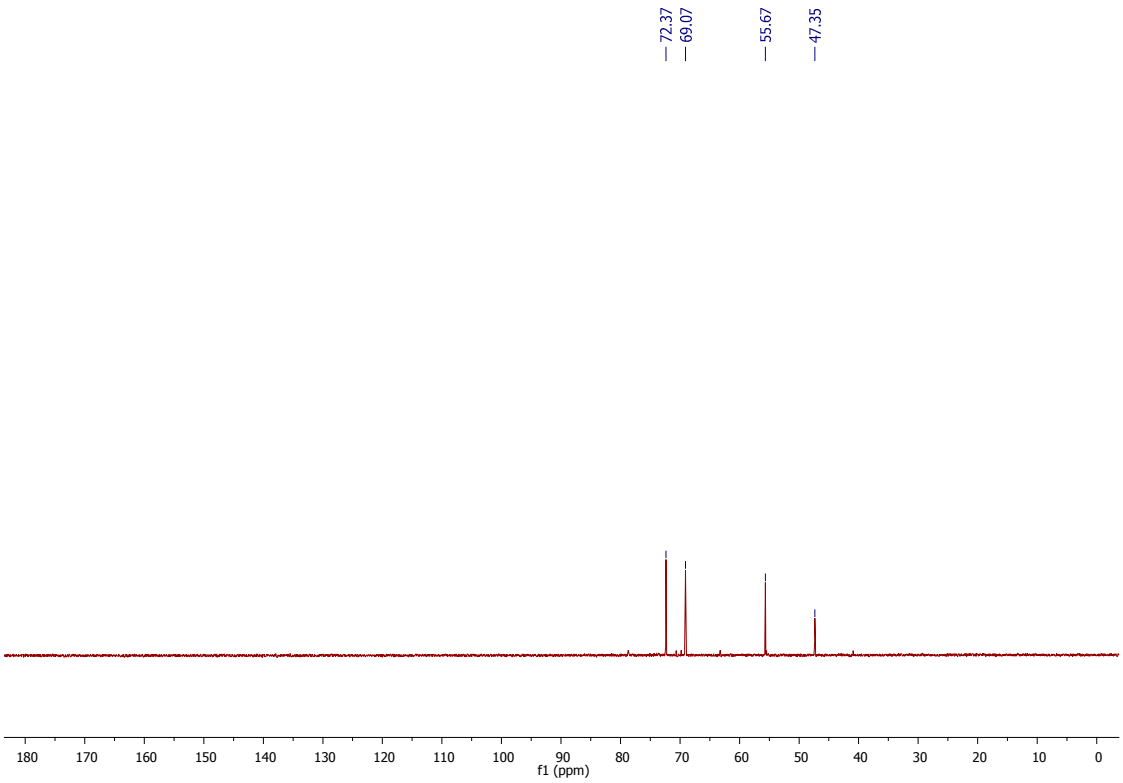




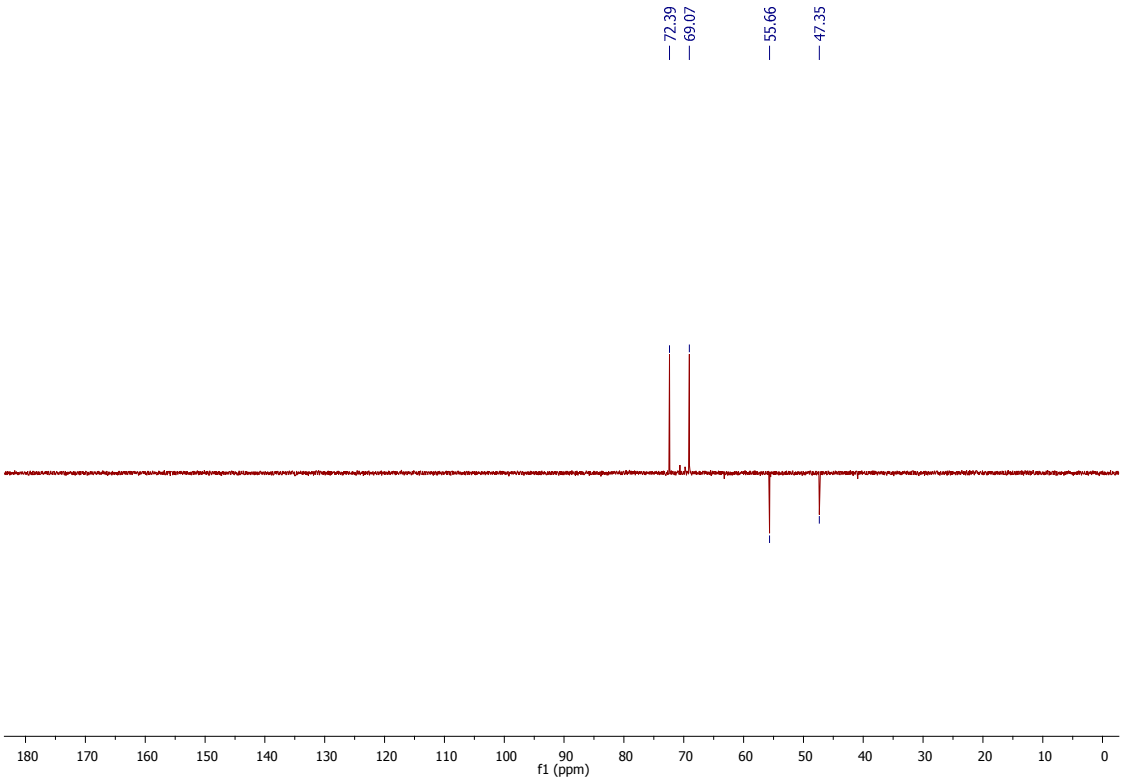
^{1}H NMR (500 MHz, D_2O)



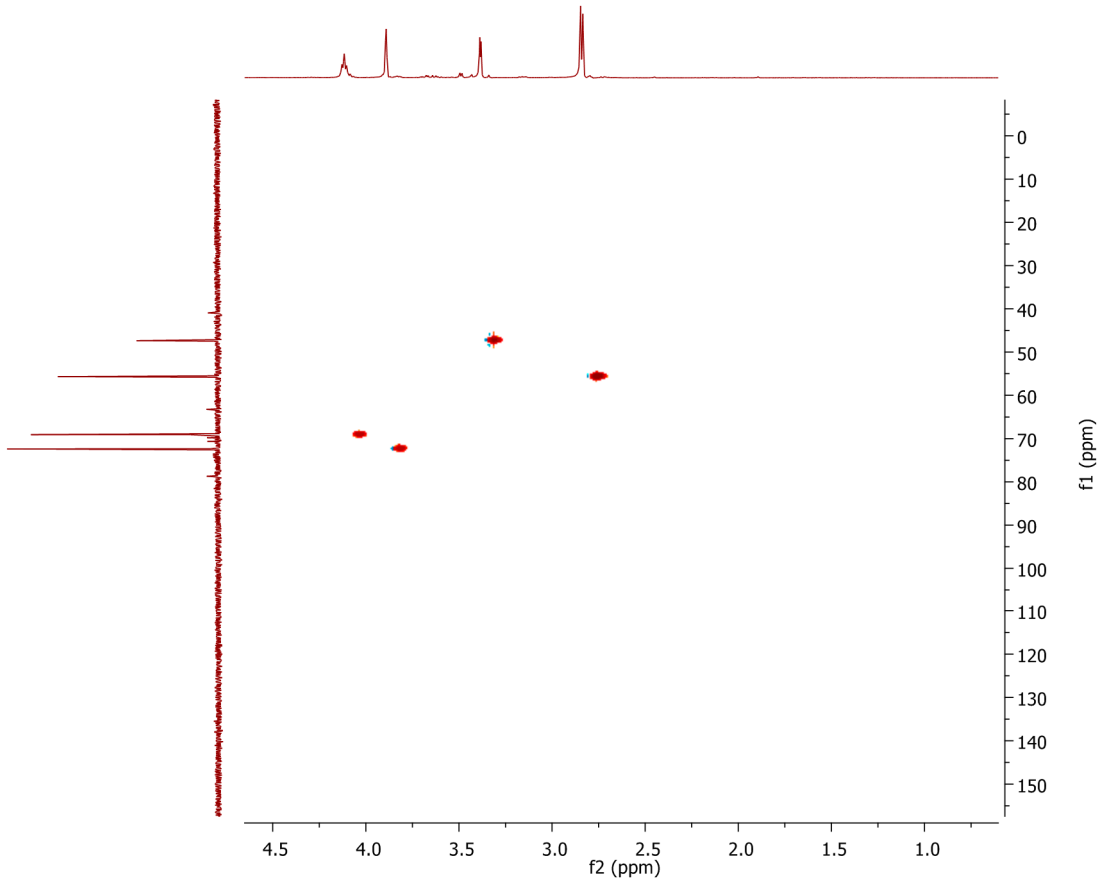
COSY NMR



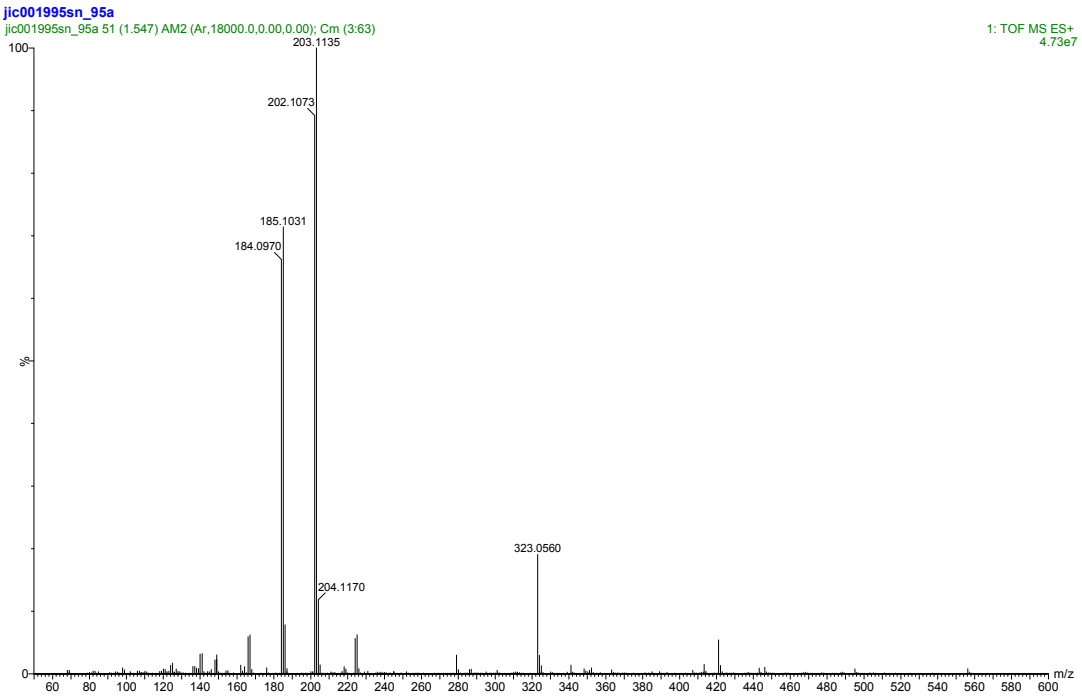
^{13}C NMR (100 MHz, D_2O)



^{13}C NMR DEPT (100 MHz, D_2O)

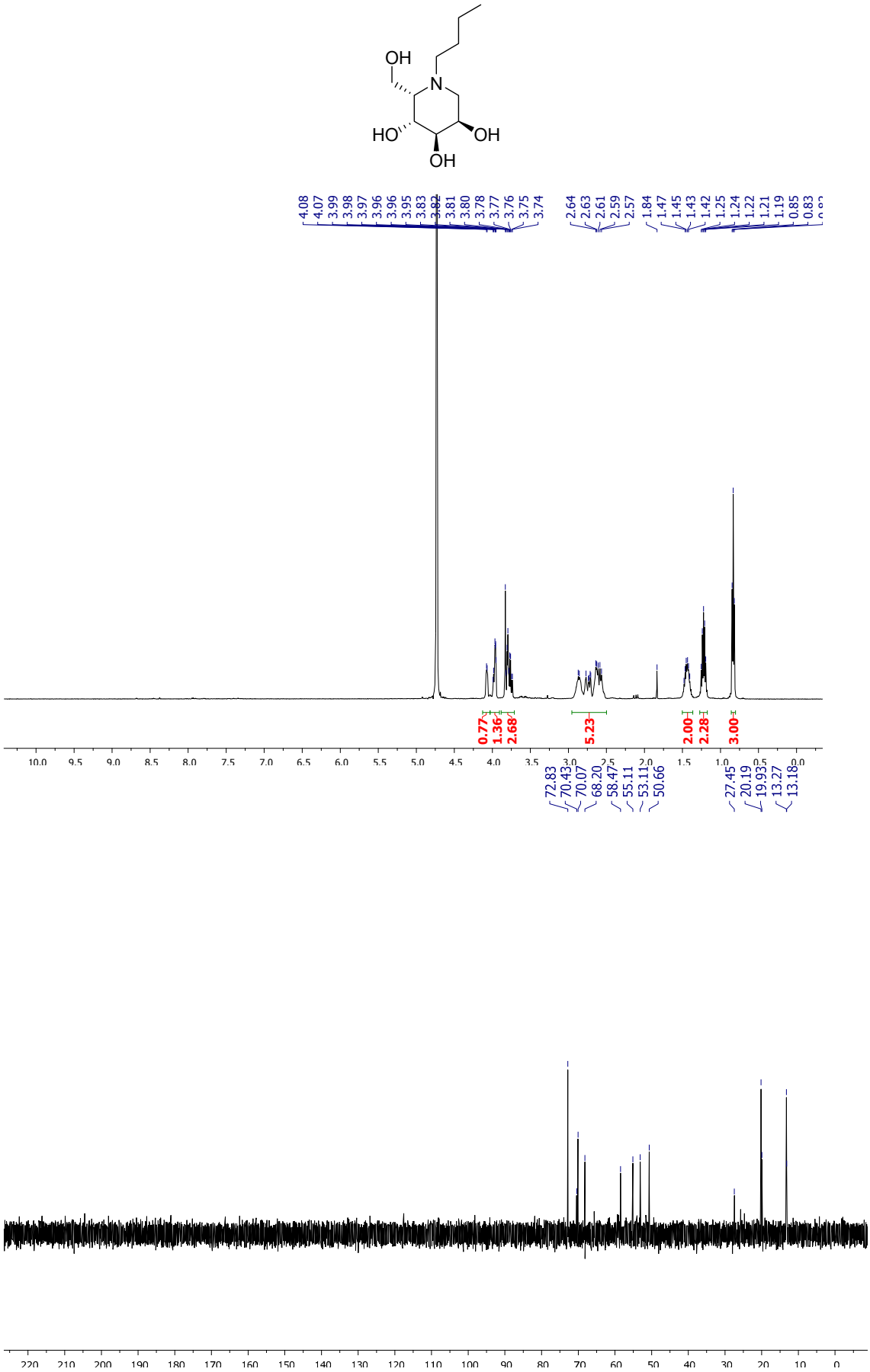


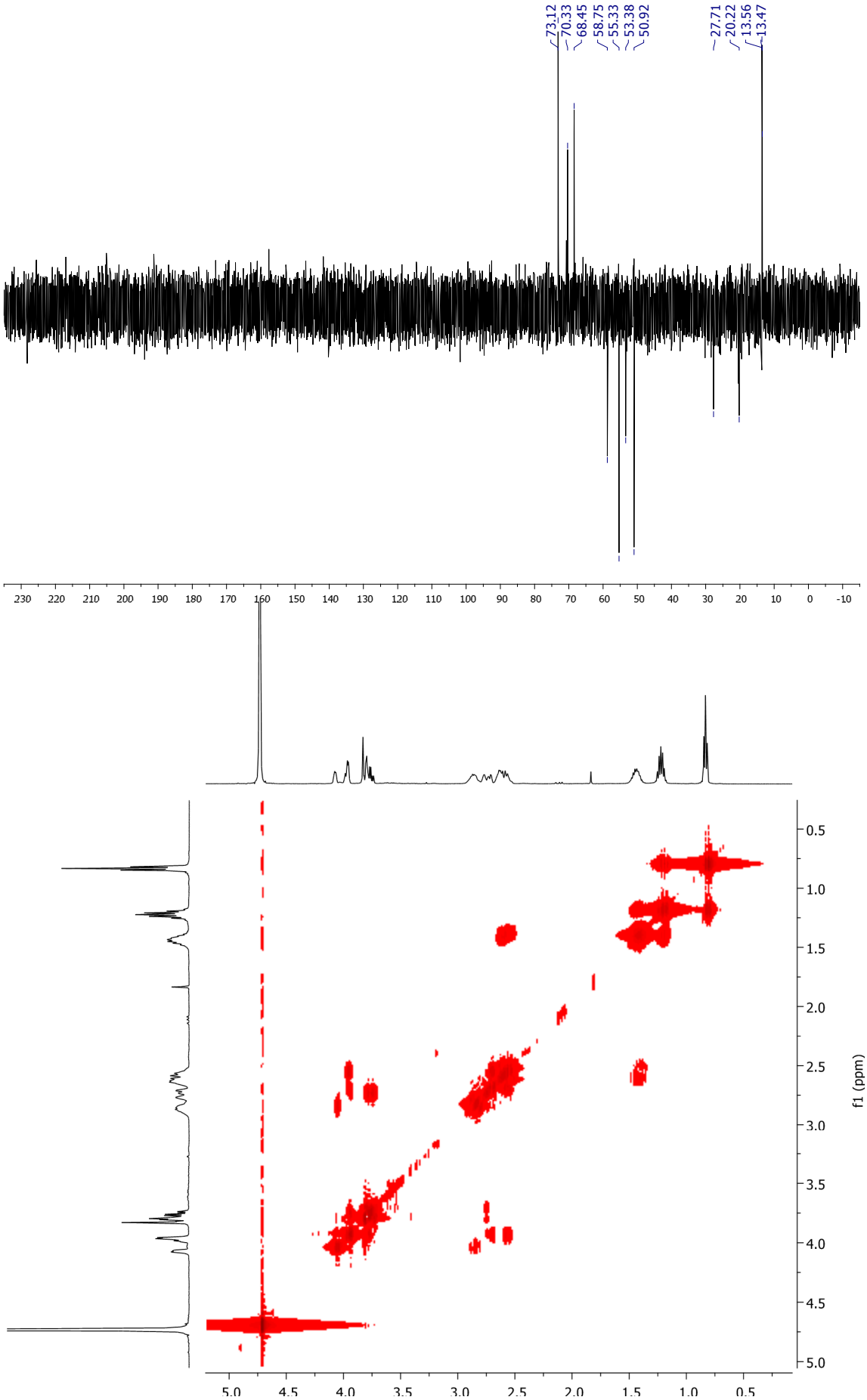
HMQC NMR



ESI HRMS: $[M+H]^+$ calcd for $C_9H_{15}NO_4$ 202.1074; found 202.1073.

_N_-Butyl-1,5-dideoxy-1,5-imino-L-gulitol (27a):

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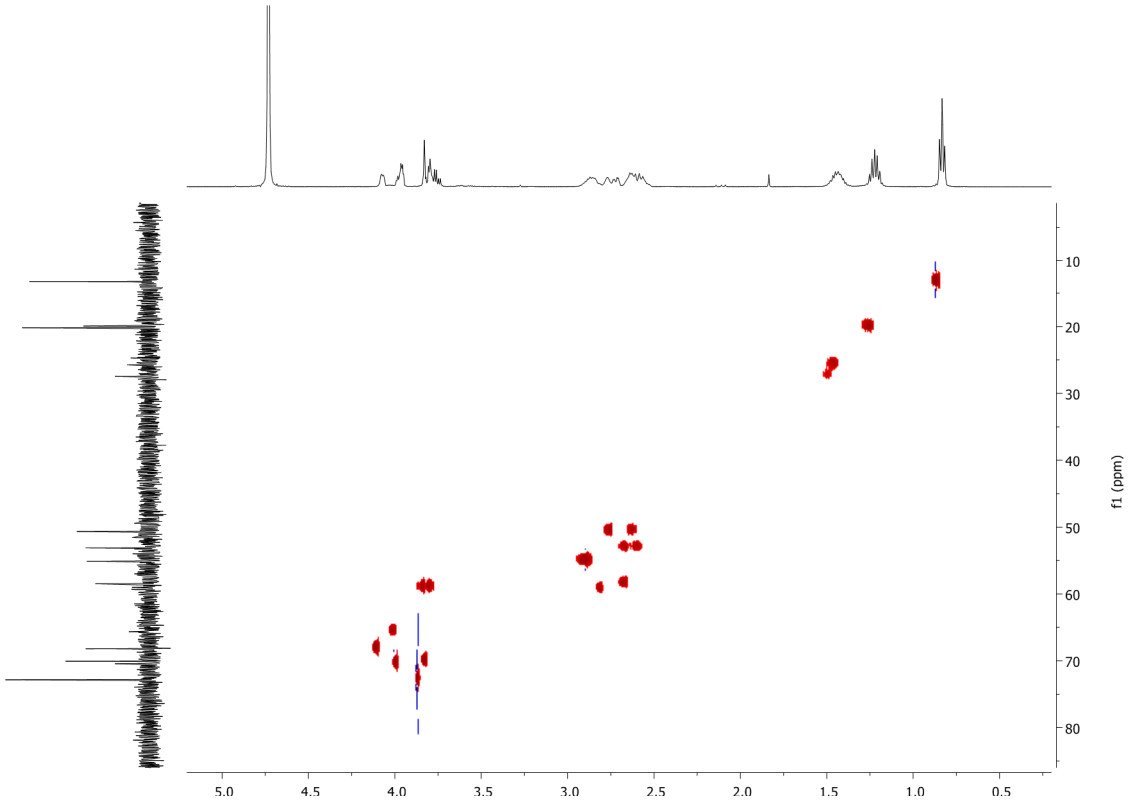
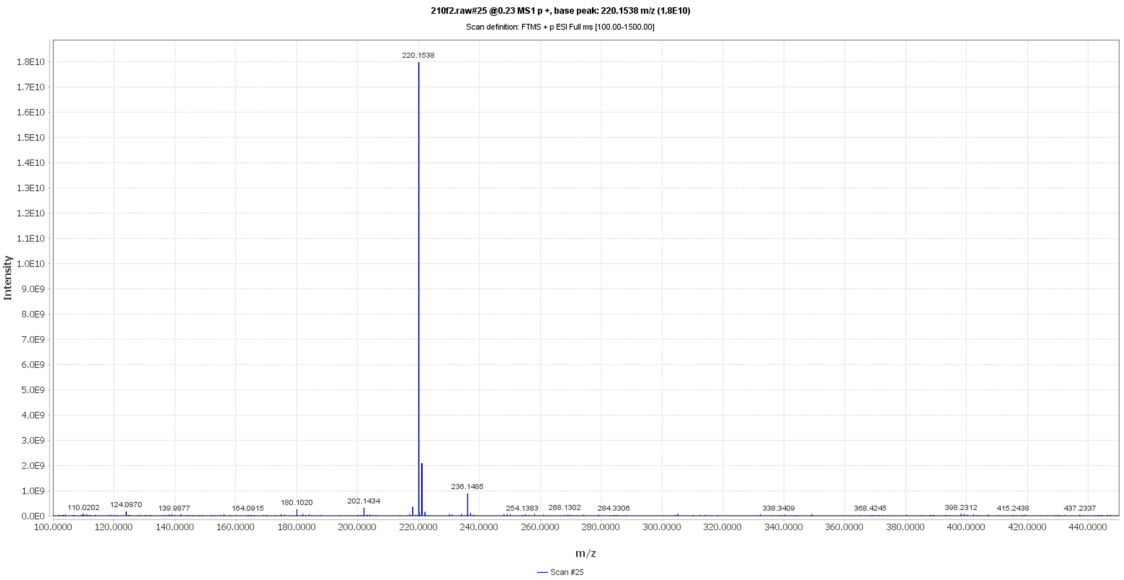
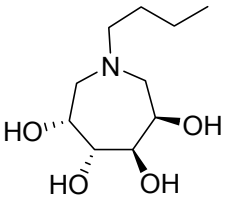
58.75
55.33
53.38
50.92
27.71
20.22
13.56
13.47
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
f1 (ppm)
5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5

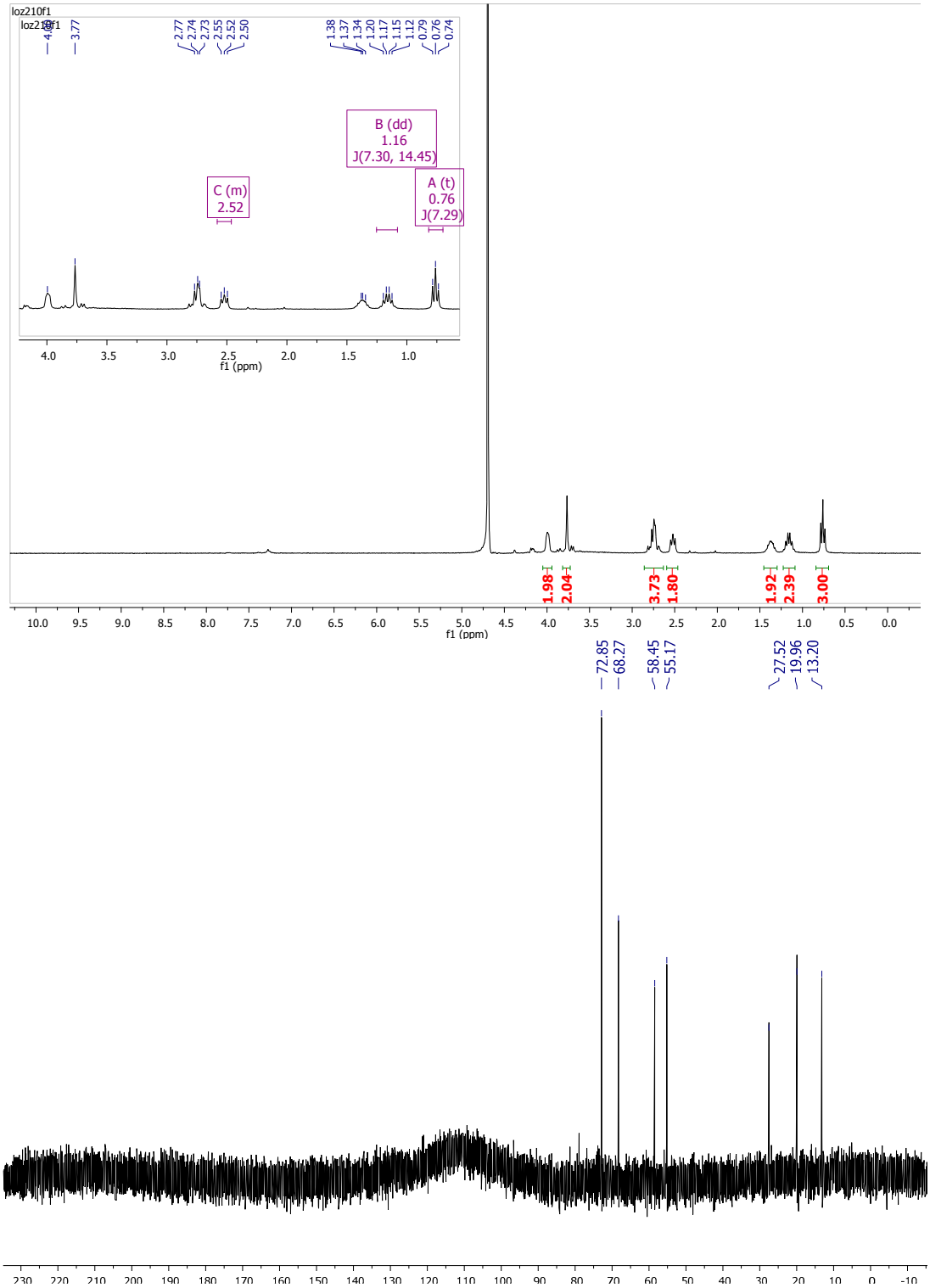


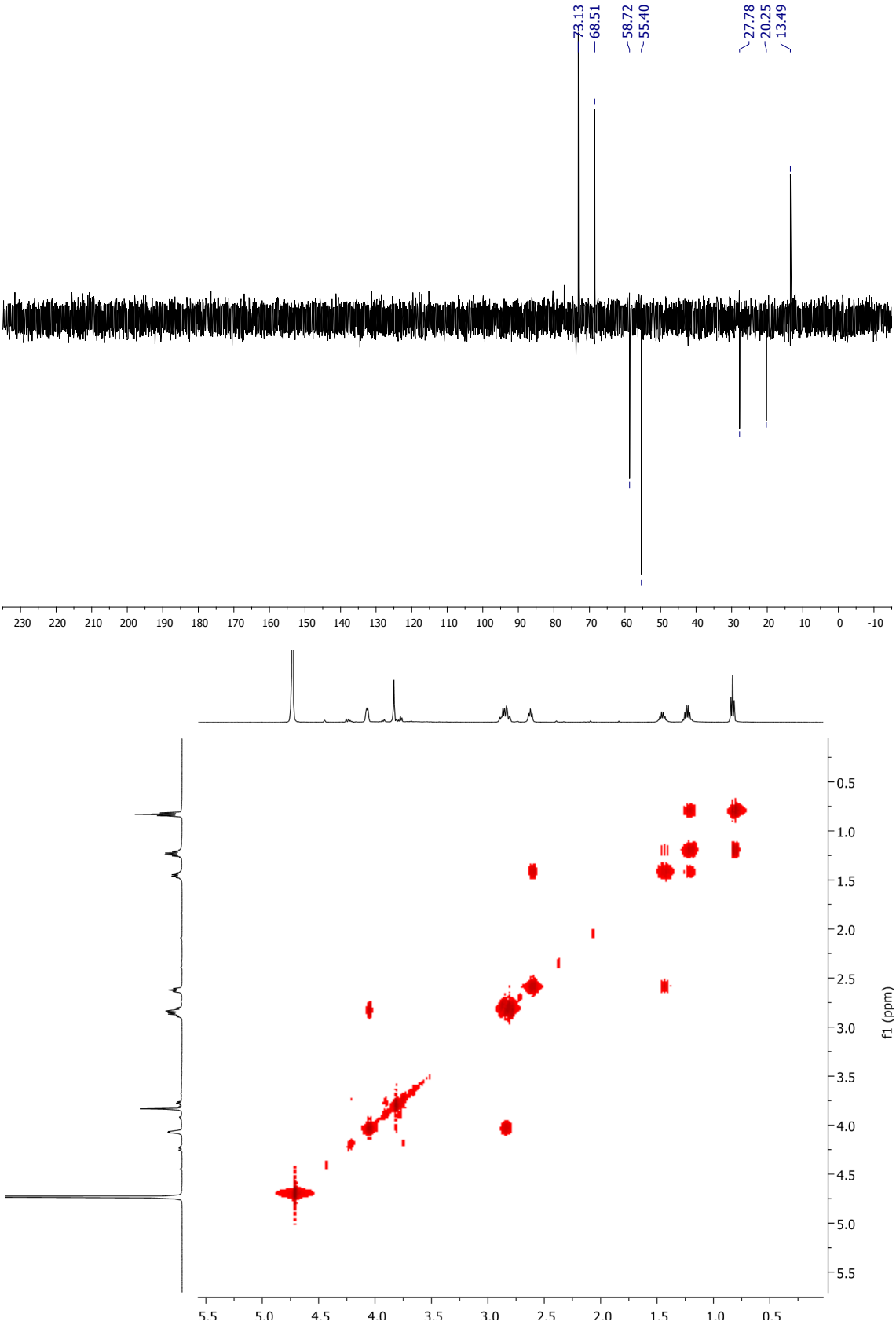


ESI HRMS: $[M+H]^+$ calcd for $C_{10}H_{22}NO_4$ 220.1544; found 220.1538.

_N_-Butyl-1,6-dideoxy-1,6-imino-D-mannitol (27b):



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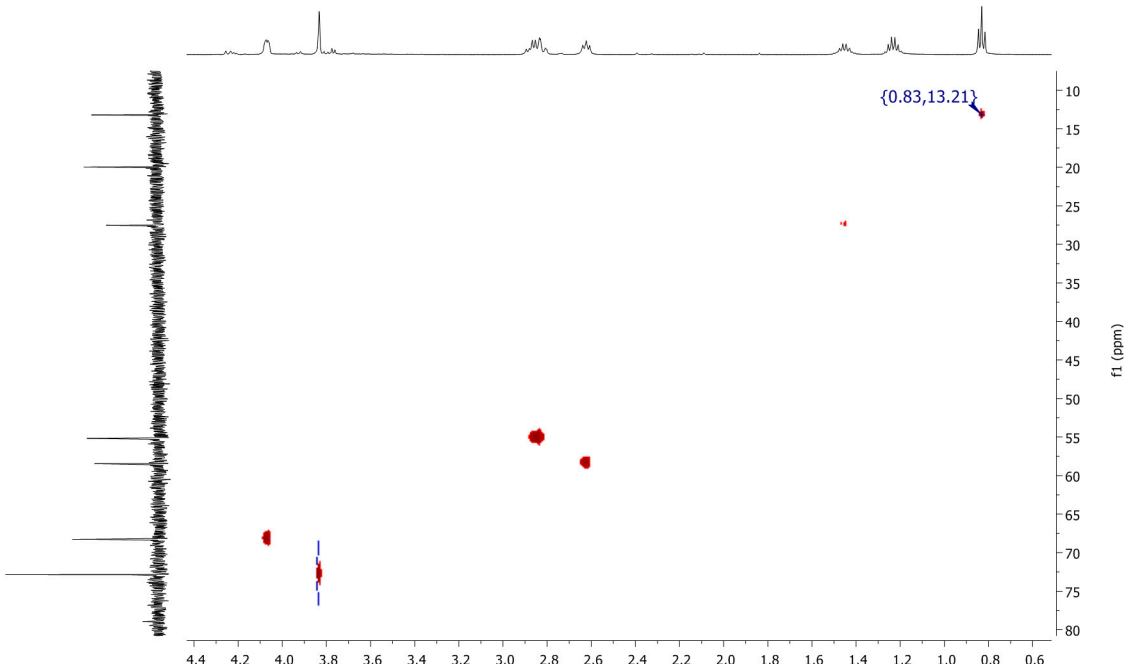
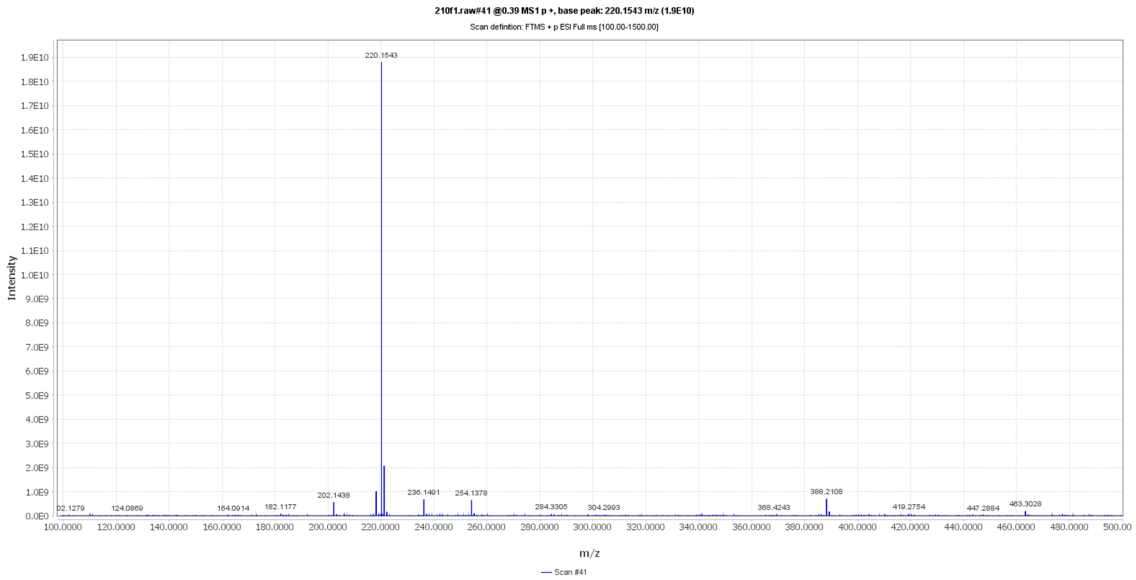
68.51
58.72
55.40
27.78
20.25
13.49
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10
0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5
f1 (ppm)
5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5





ESI HRMS: $[M+H]^+$ calcd for $C_{10}H_{22}NO_4$ 220.1544; found 220.1543

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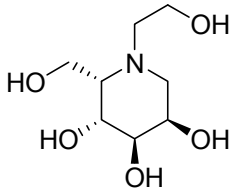

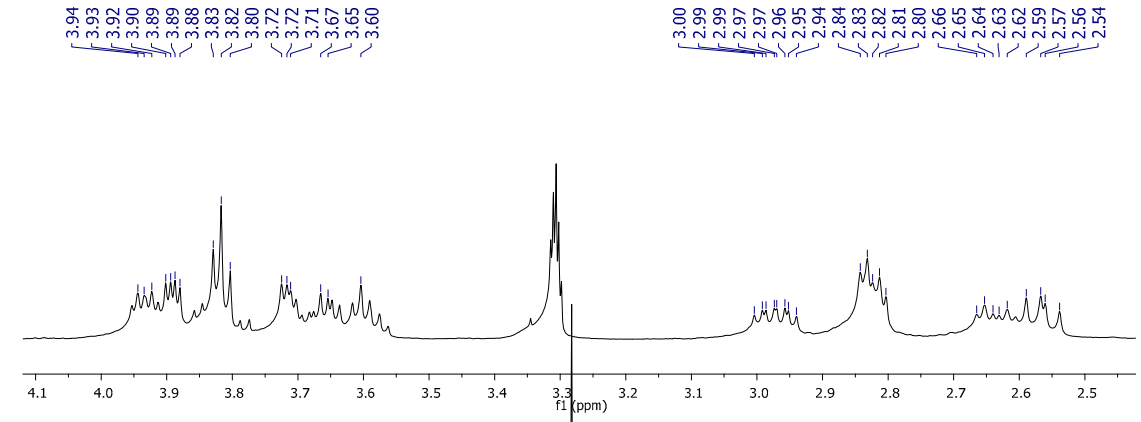

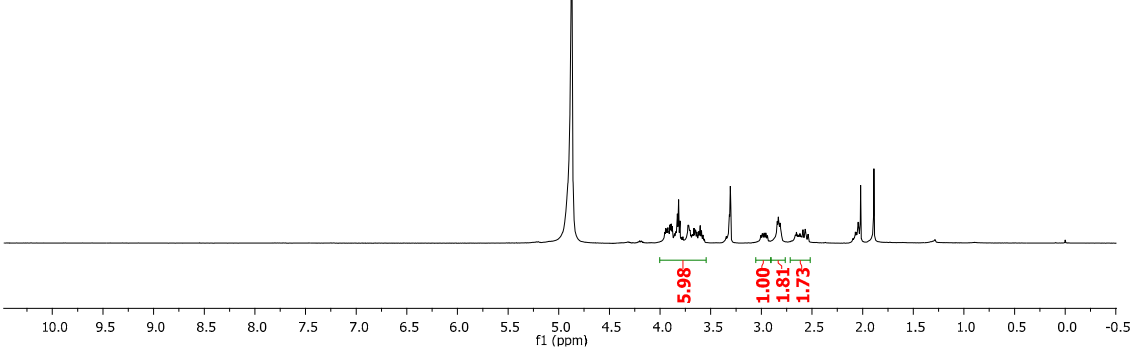

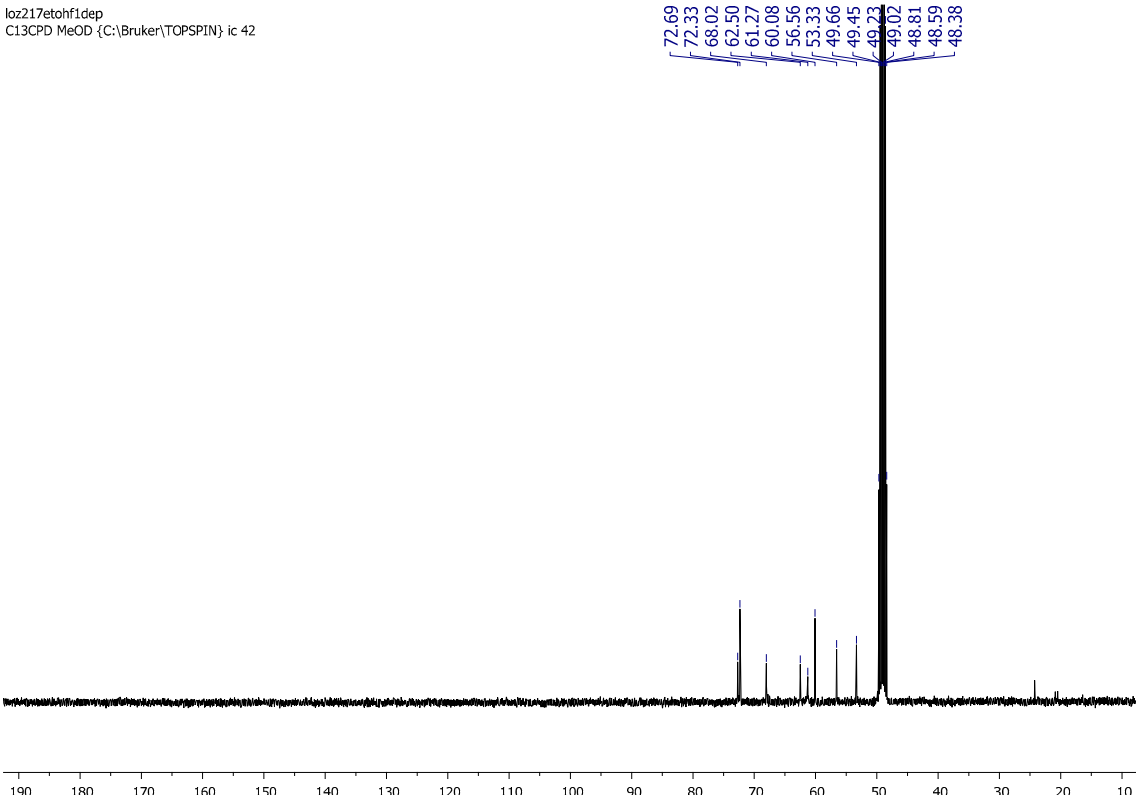

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62.48
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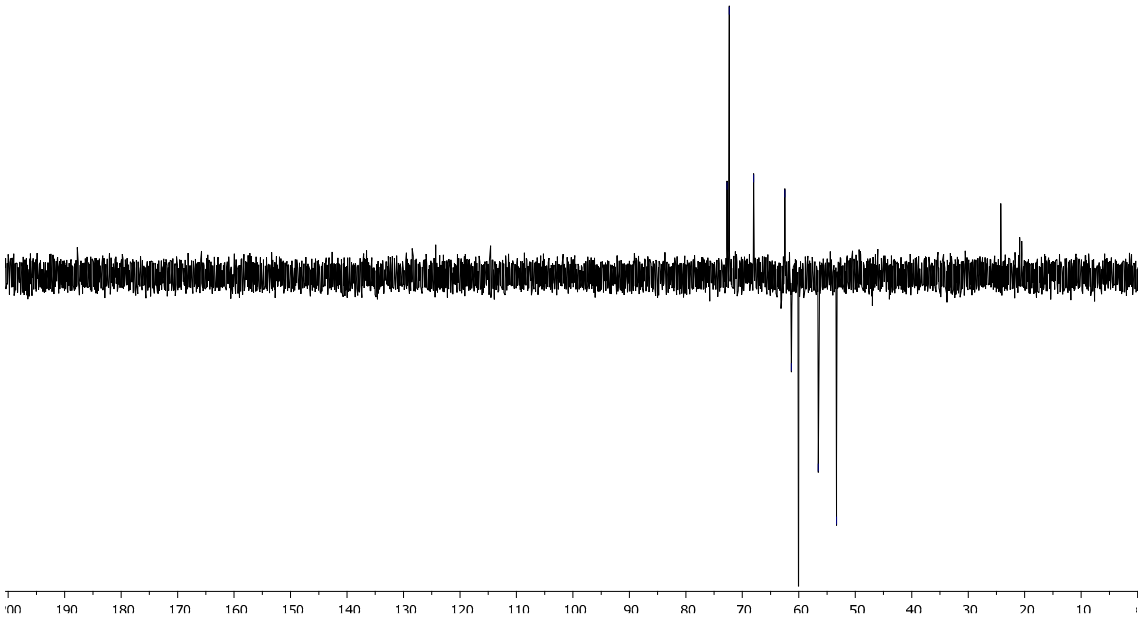
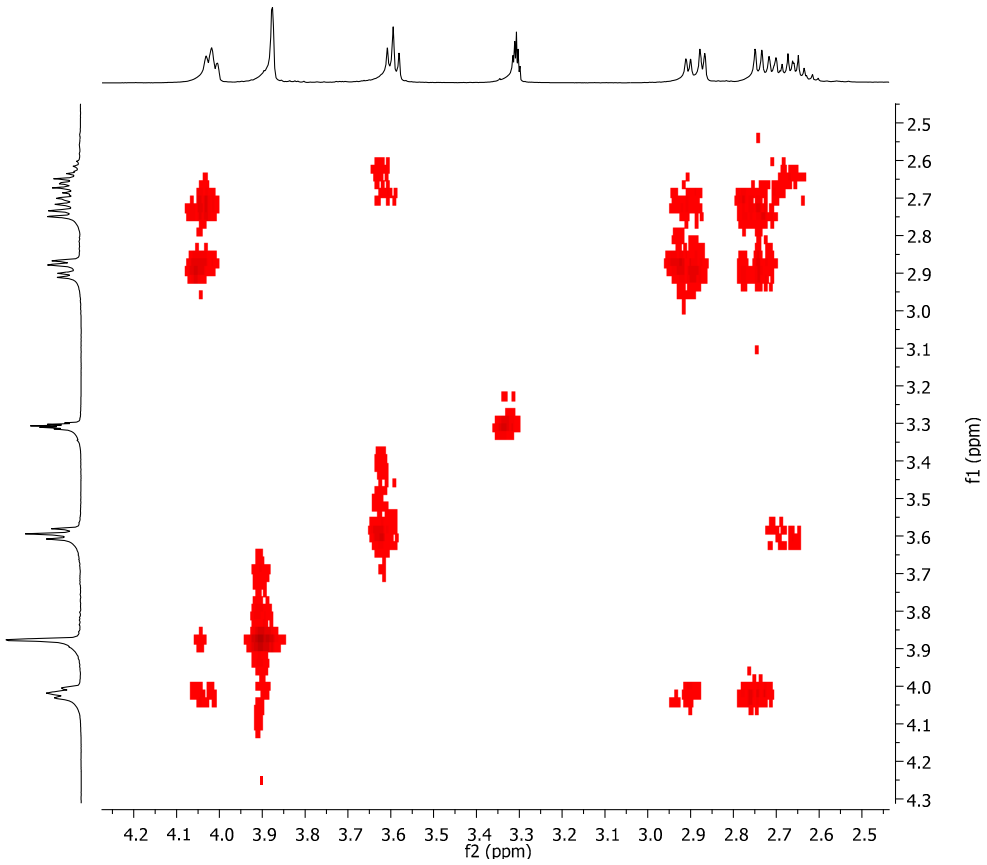
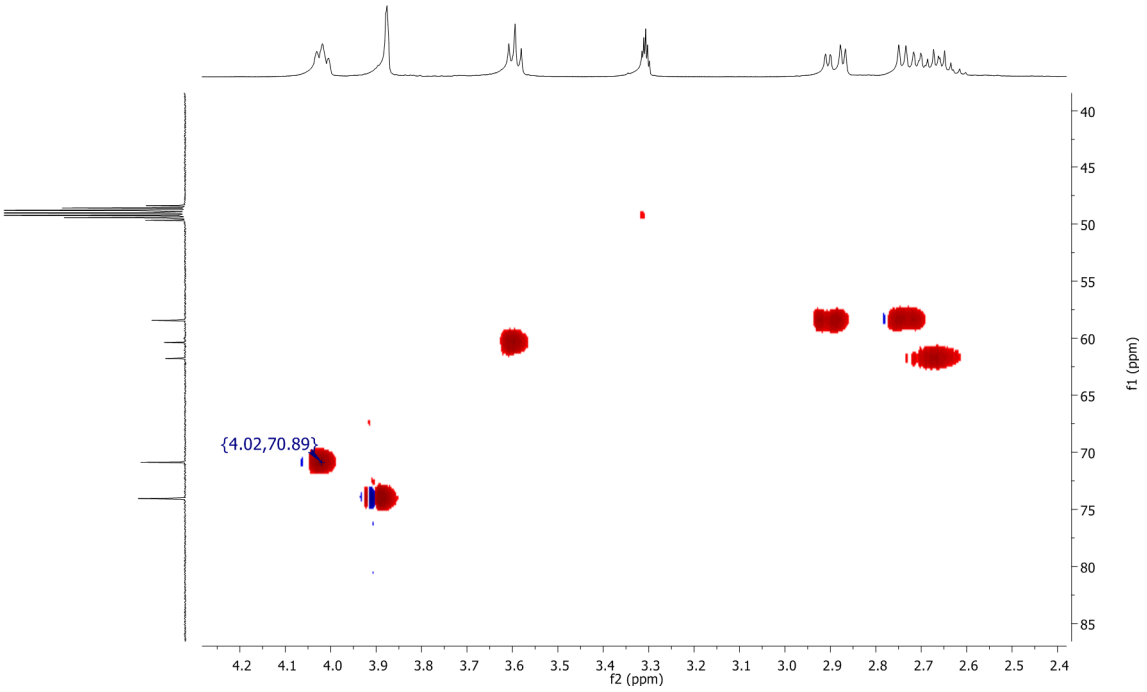
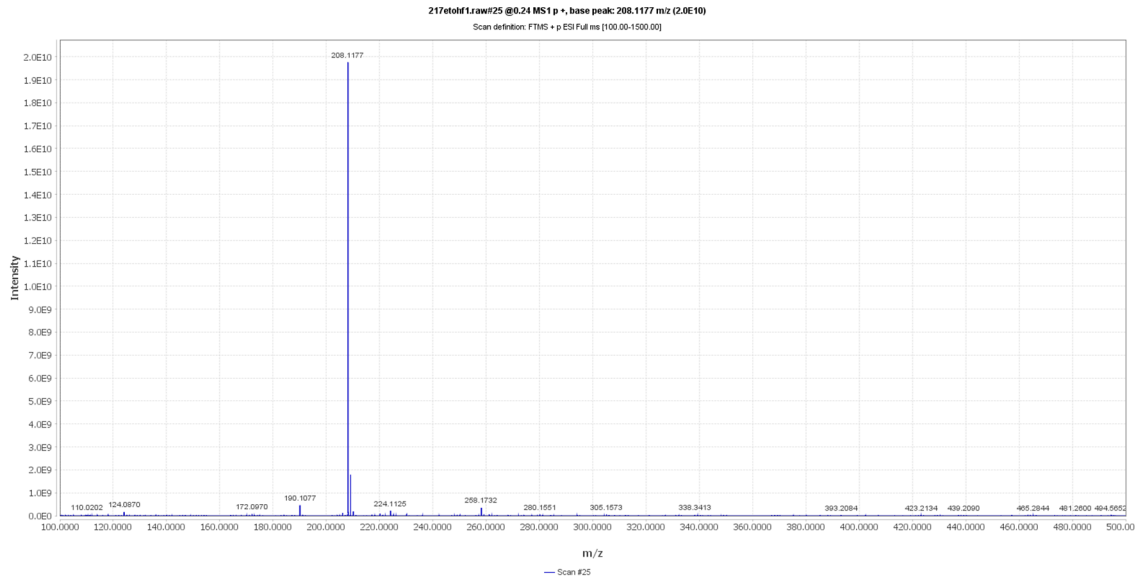
56.54
53.32



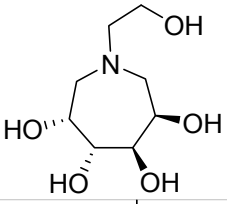


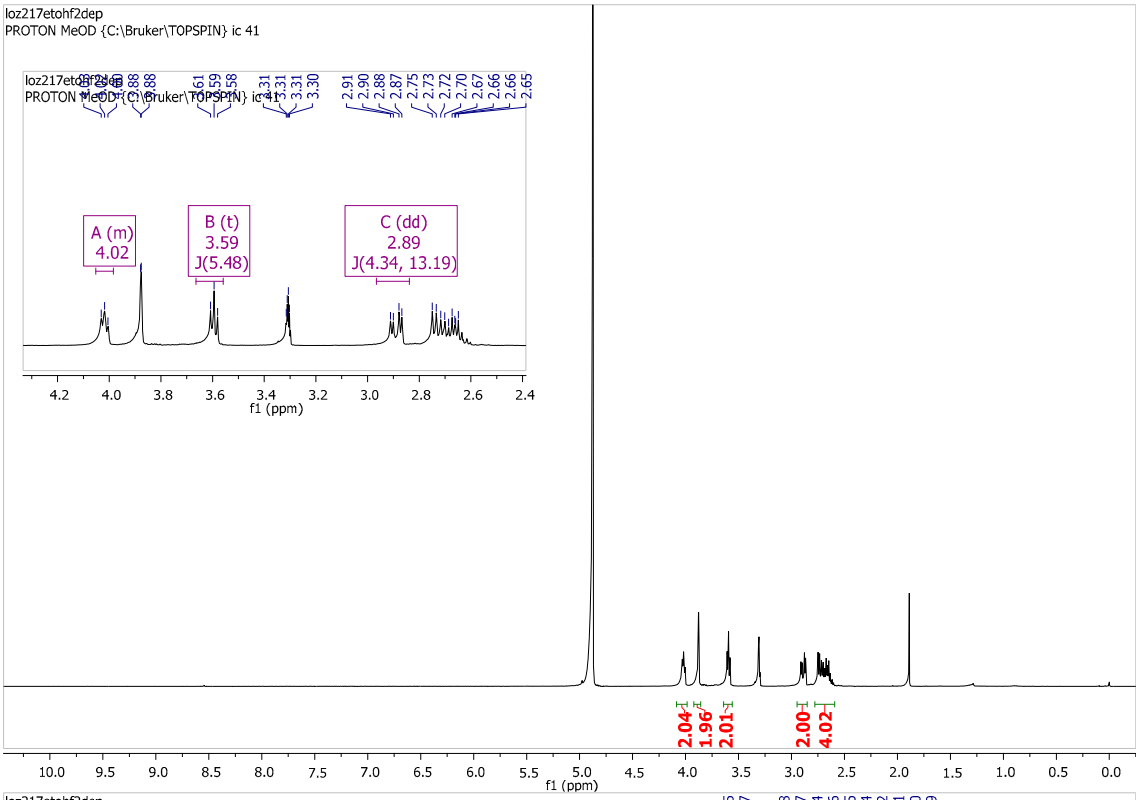


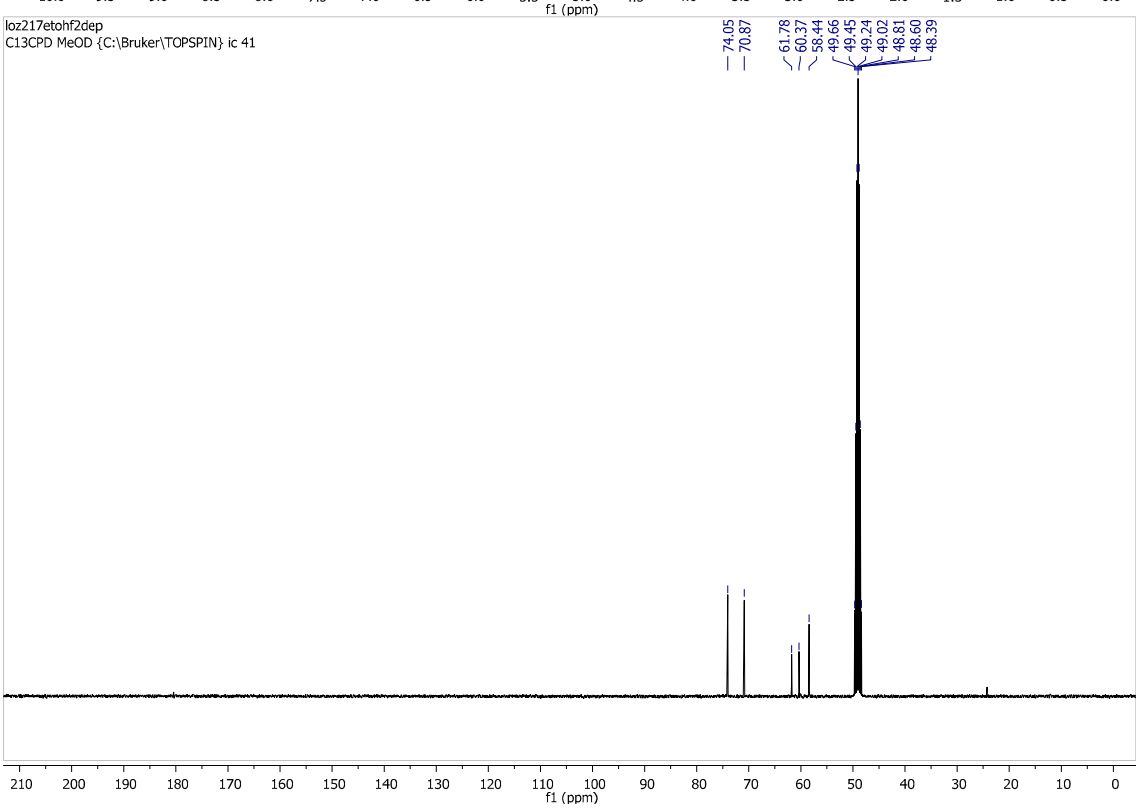


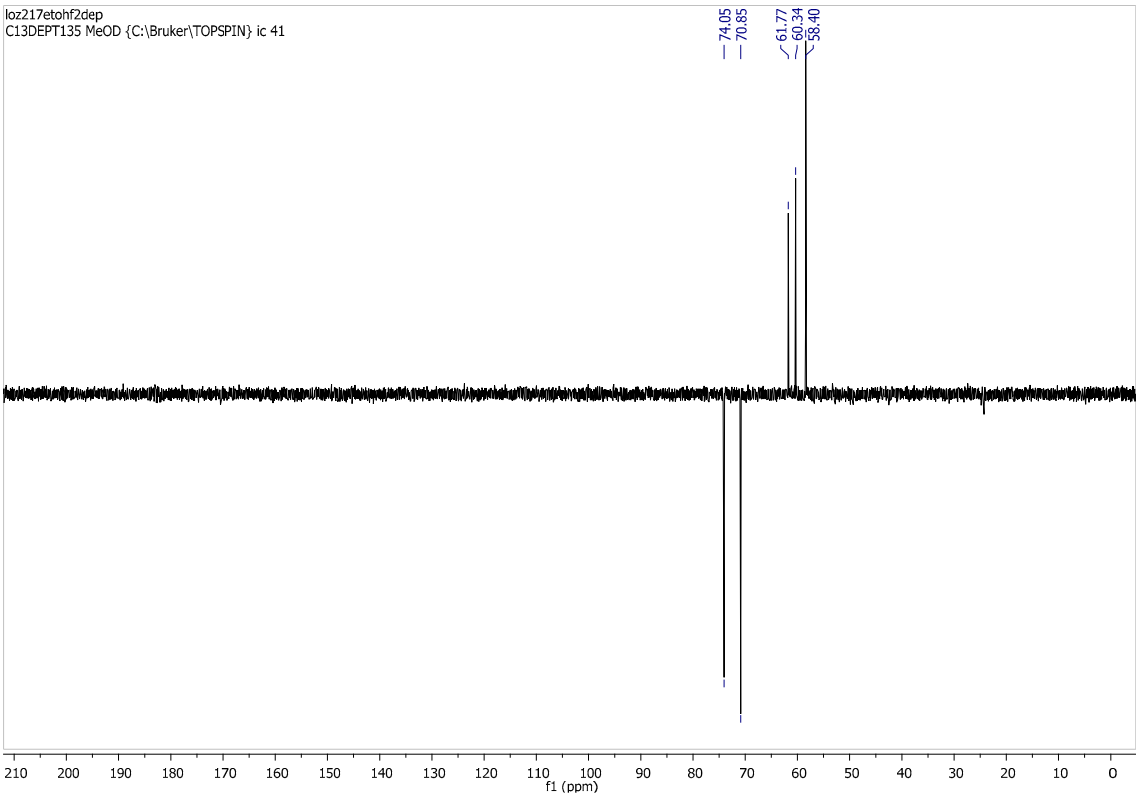
ESI HRMS: $[M+H]^+$ calcd for $C_8H_{18}NO_5$ 208.1180; found 208.1177

_N_-Hydroxyethyl-1,6-imino-D-mannitol (28b):





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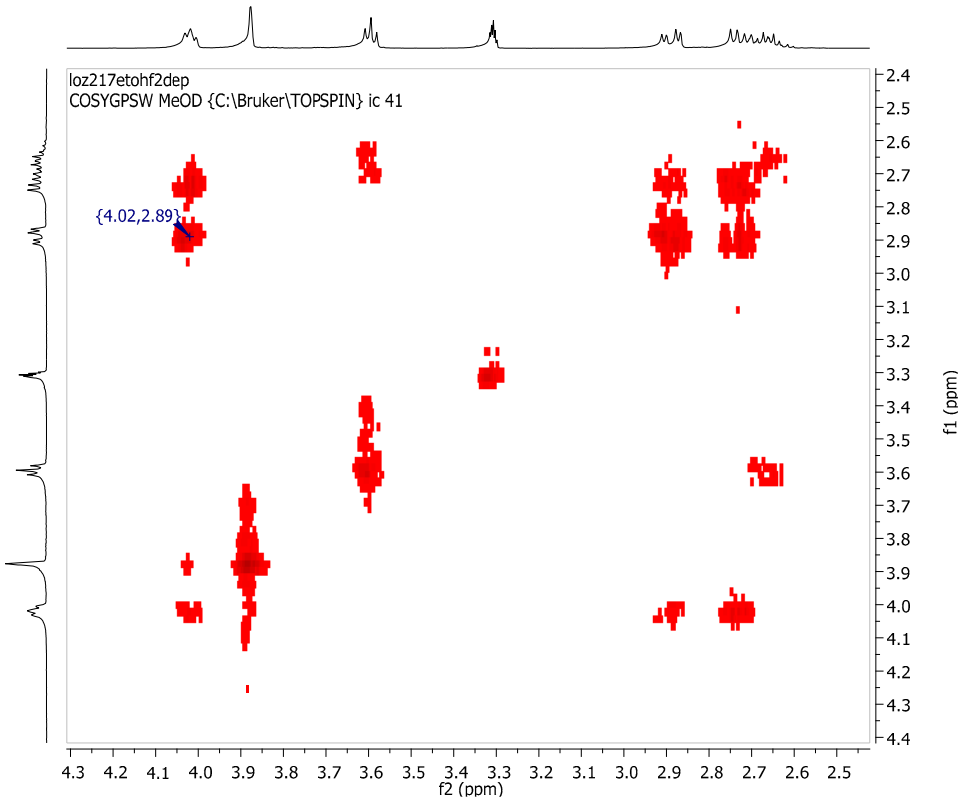
f1 (ppm)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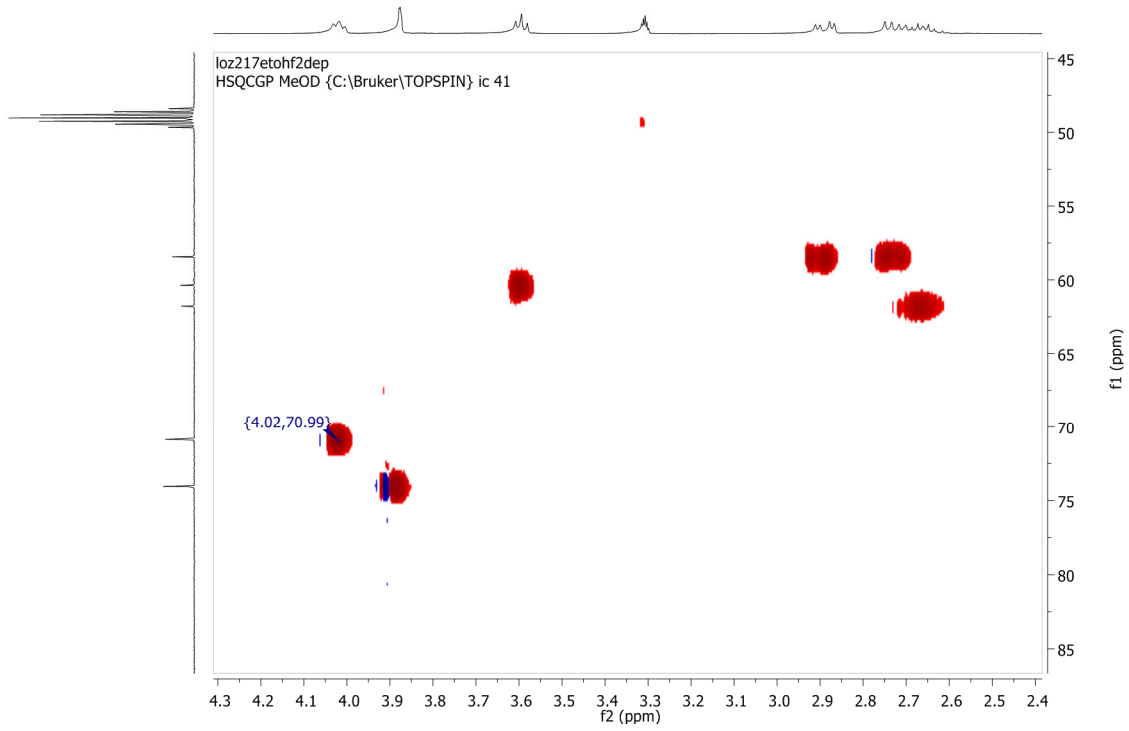
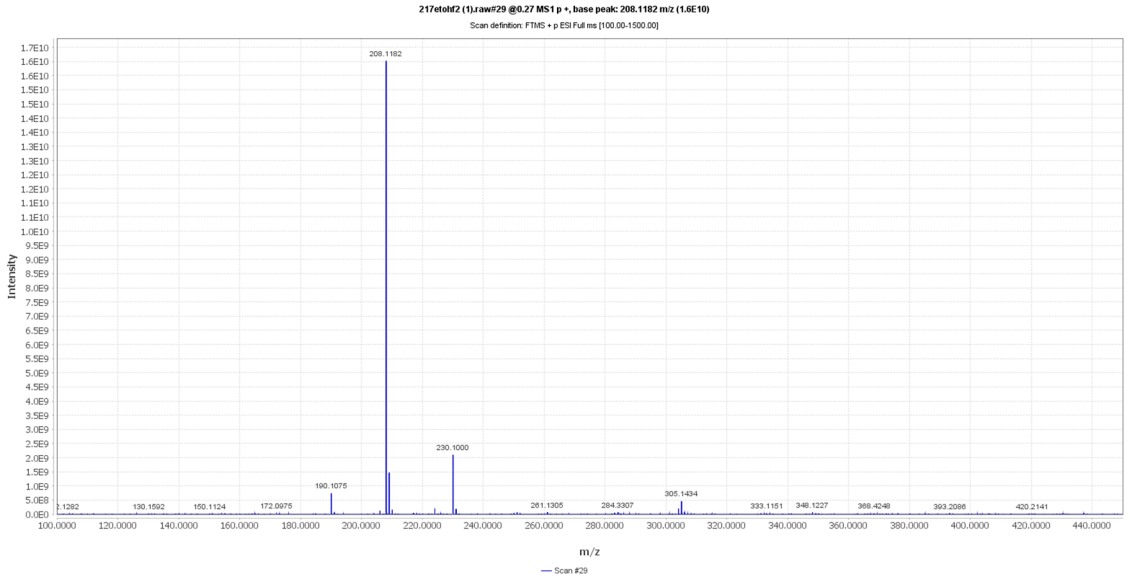
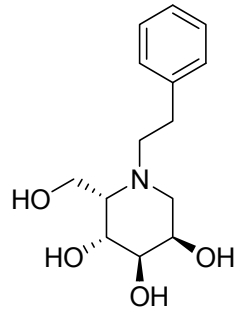
f1 (ppm)

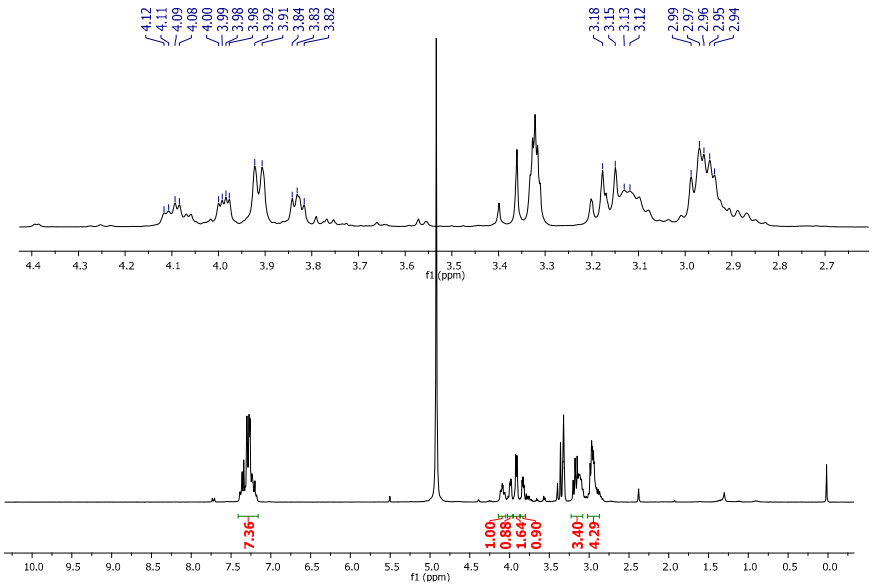


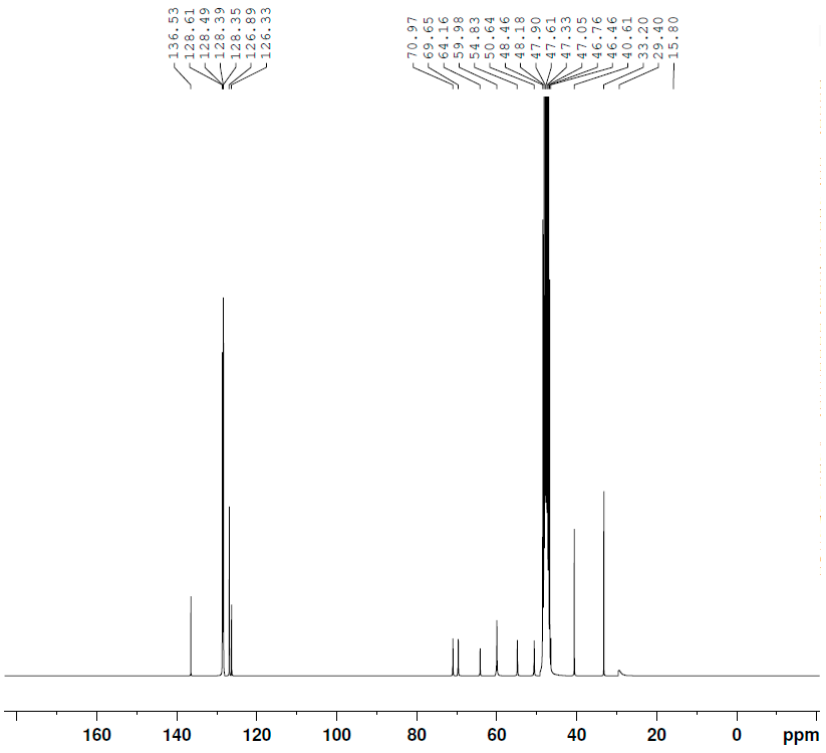


ESI HRMS: $[M+H]^+$ calcd for $C_8H_{18}NO_5$ 208.1180; found 208.1182

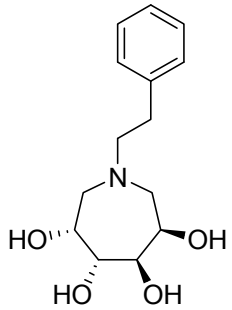
_N_-Phenethyl-1,5-dideoxy-1,5-imino-L-gulitol (29a):

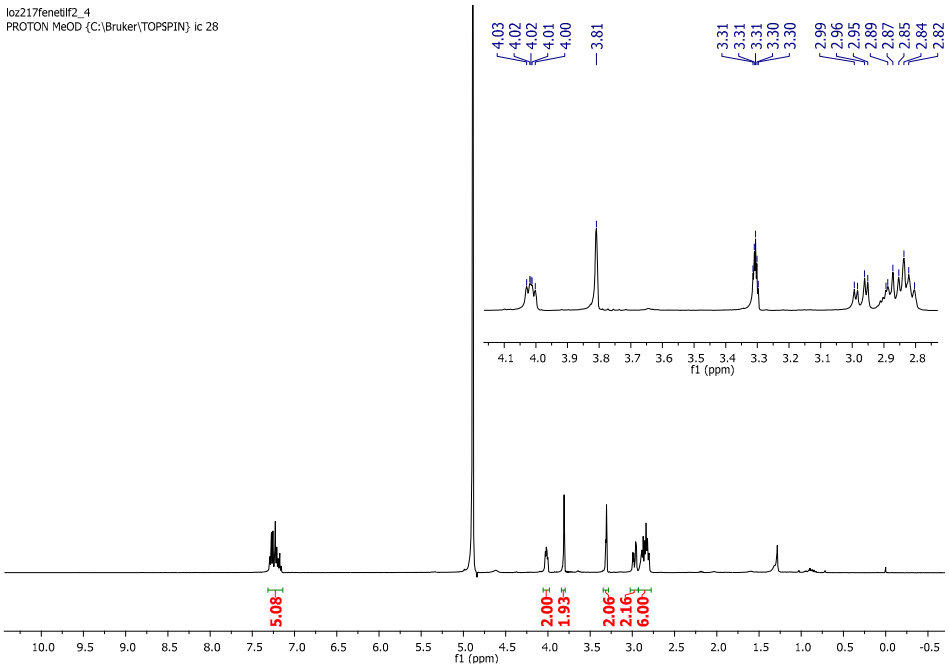


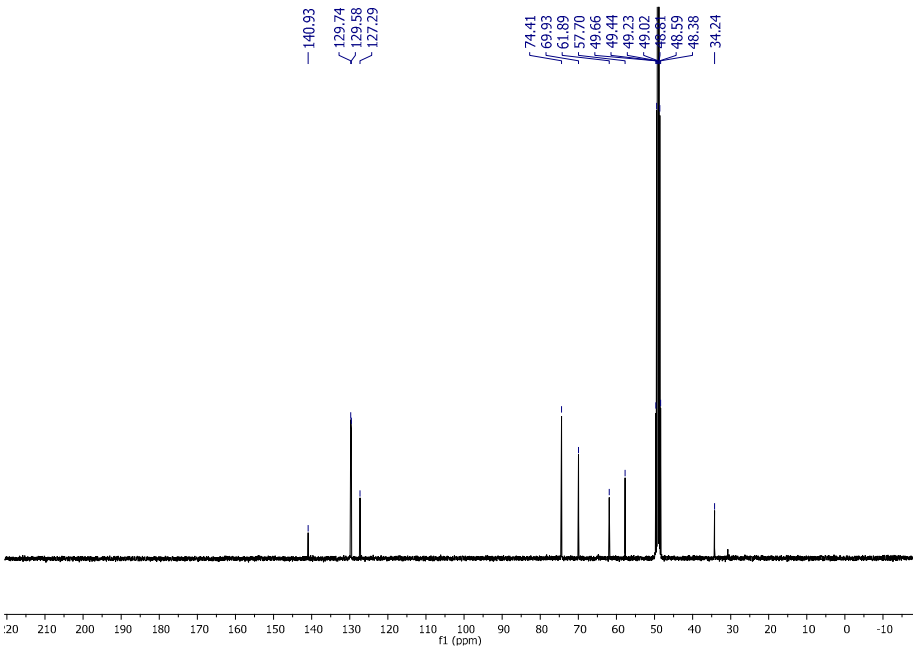


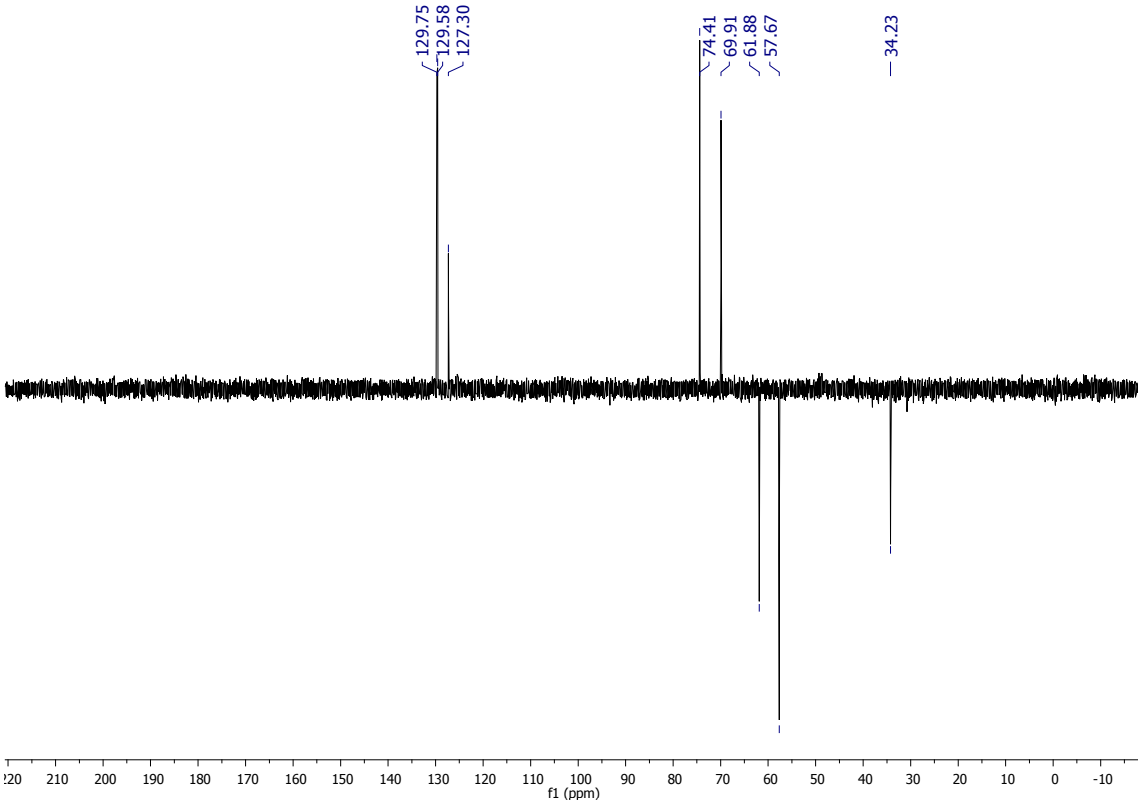


_N_-Phenetyl-1,6-dideoxy-1,6-imino-D-mannitol (29b):





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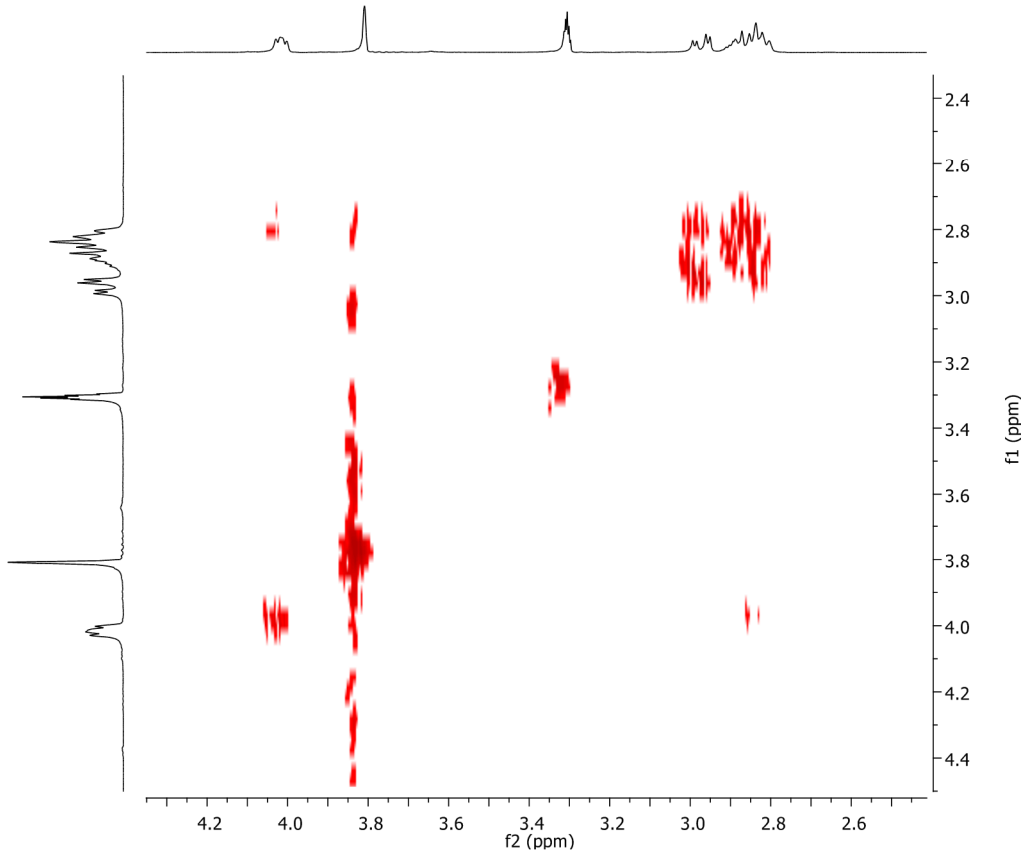
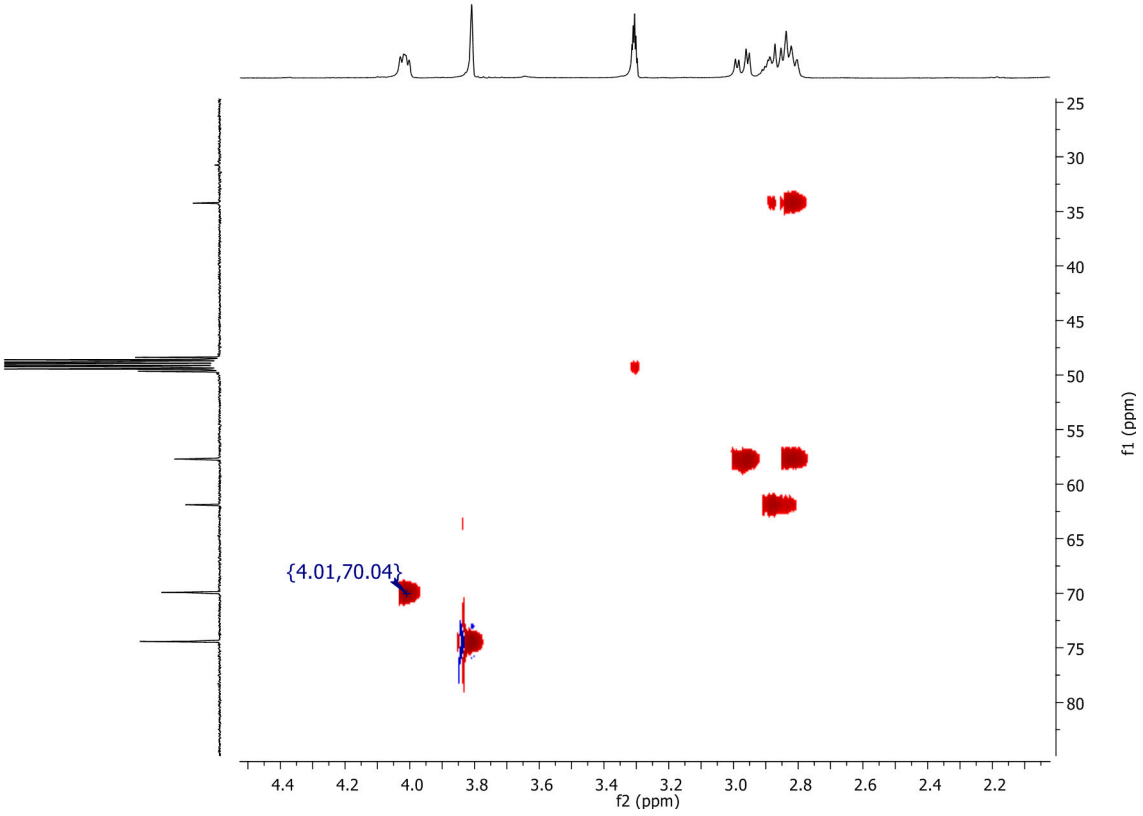
f1 (ppm)


f2 (ppm)
f1 (ppm)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f2 (ppm)
f1 (ppm)

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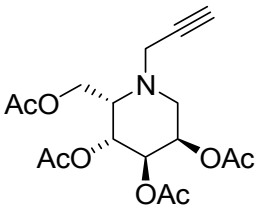

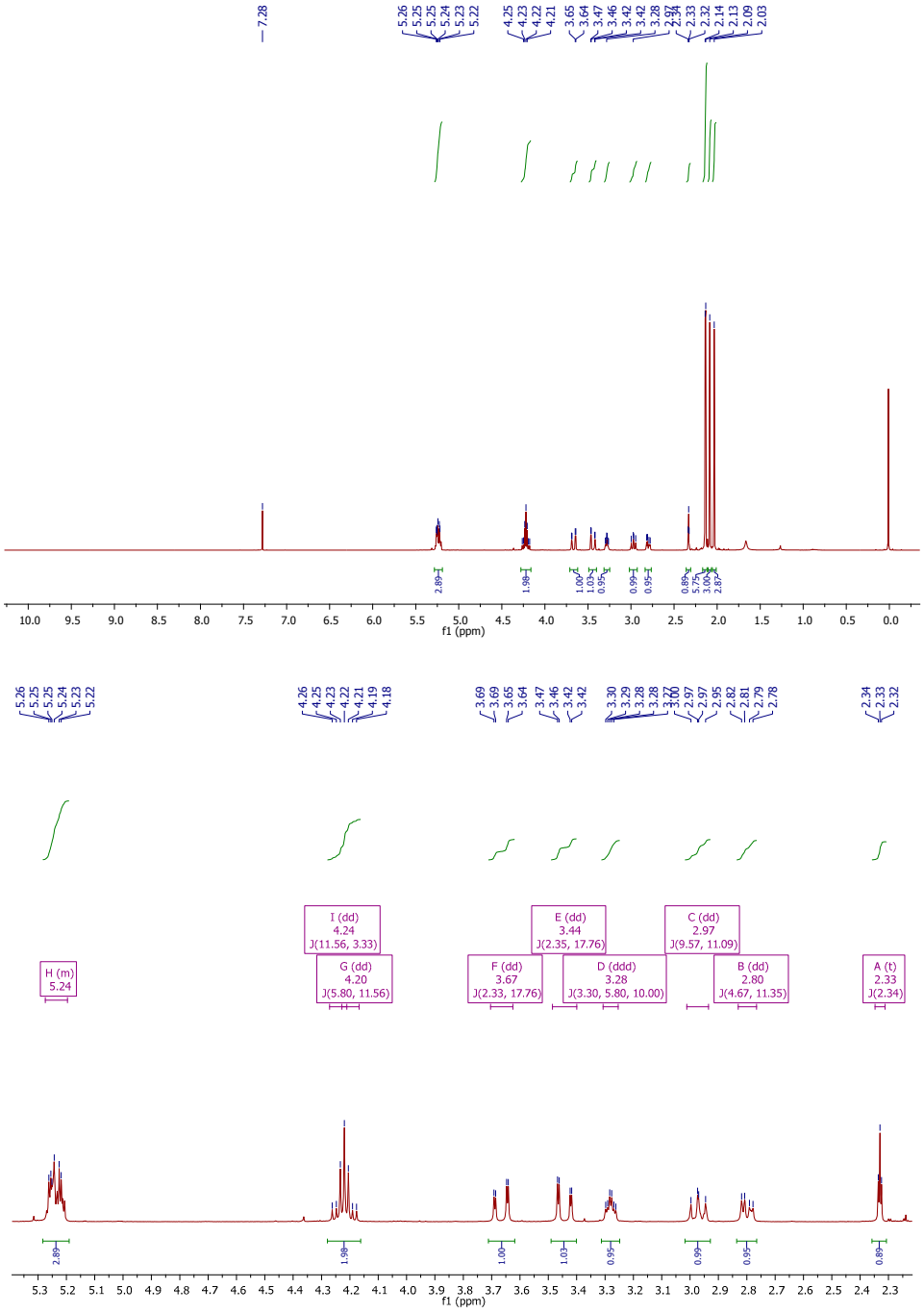

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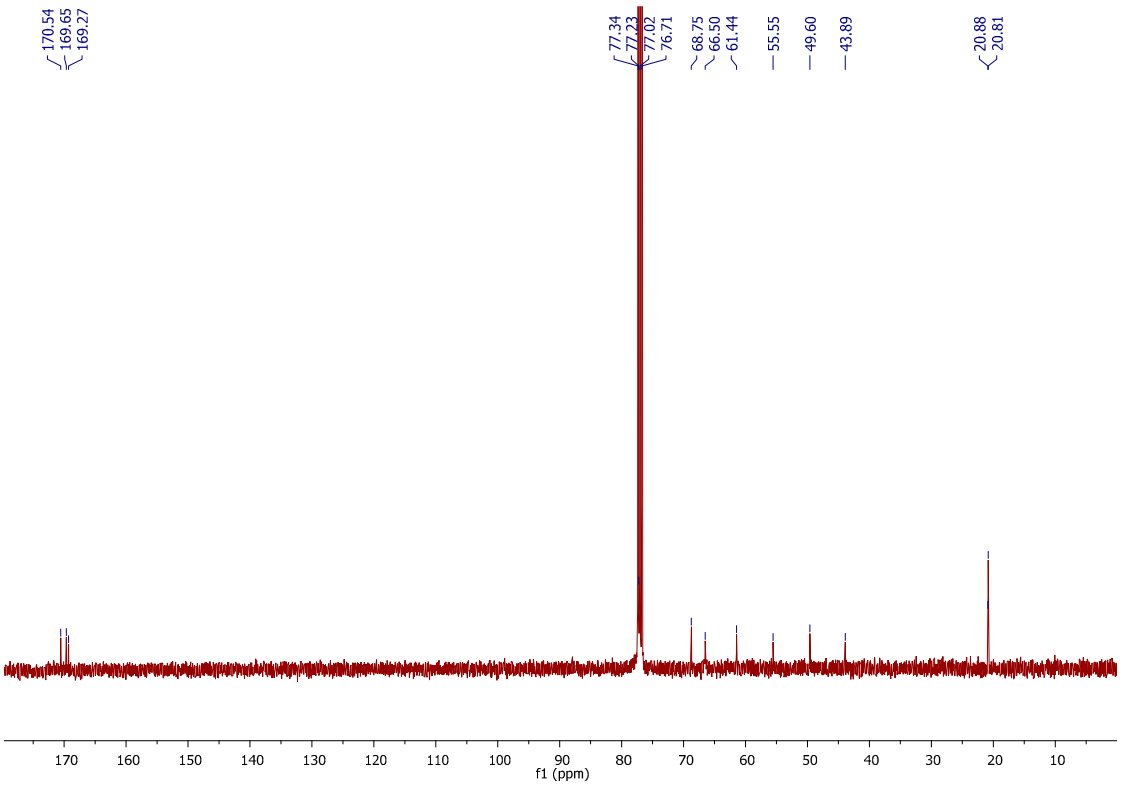
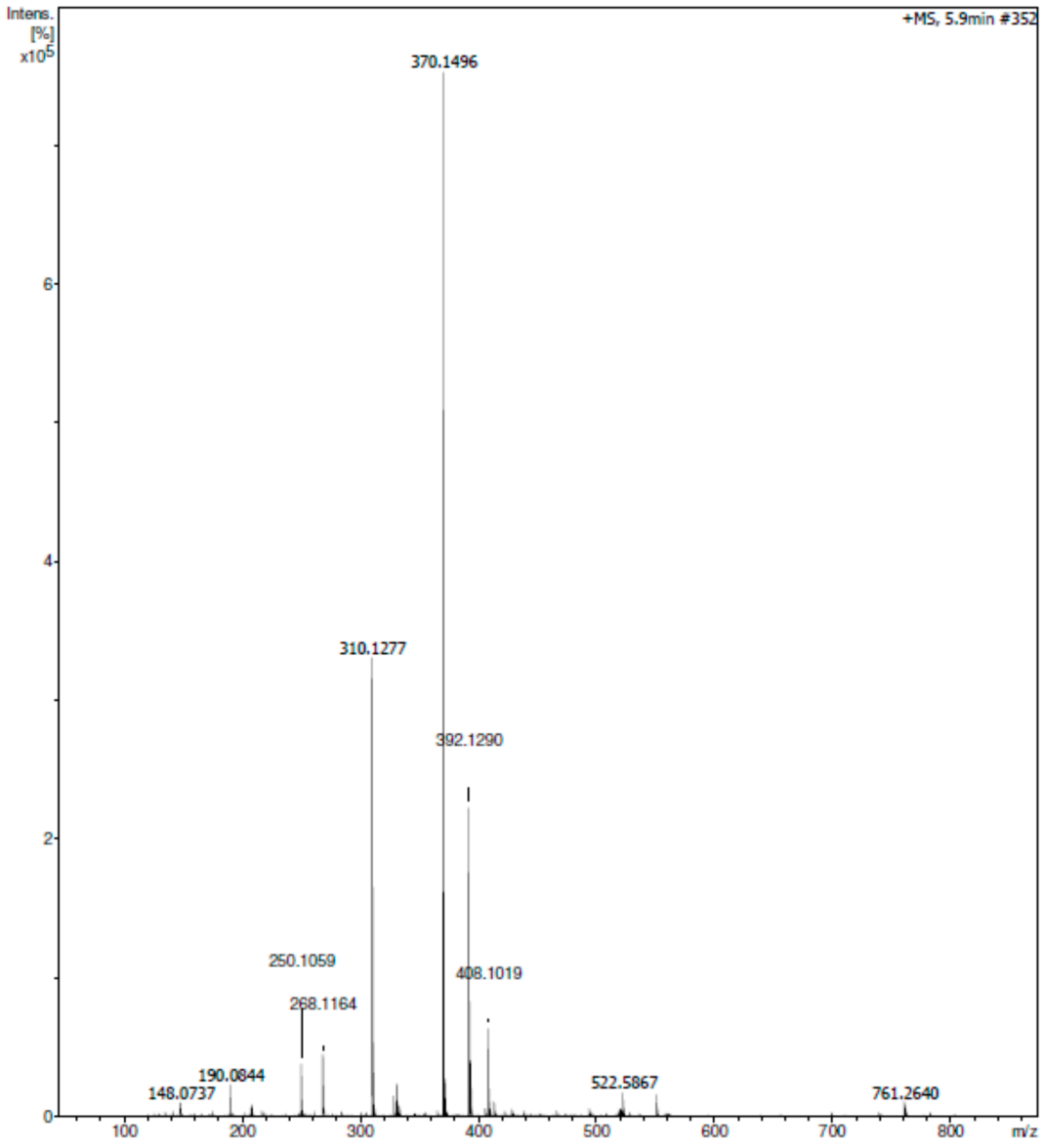
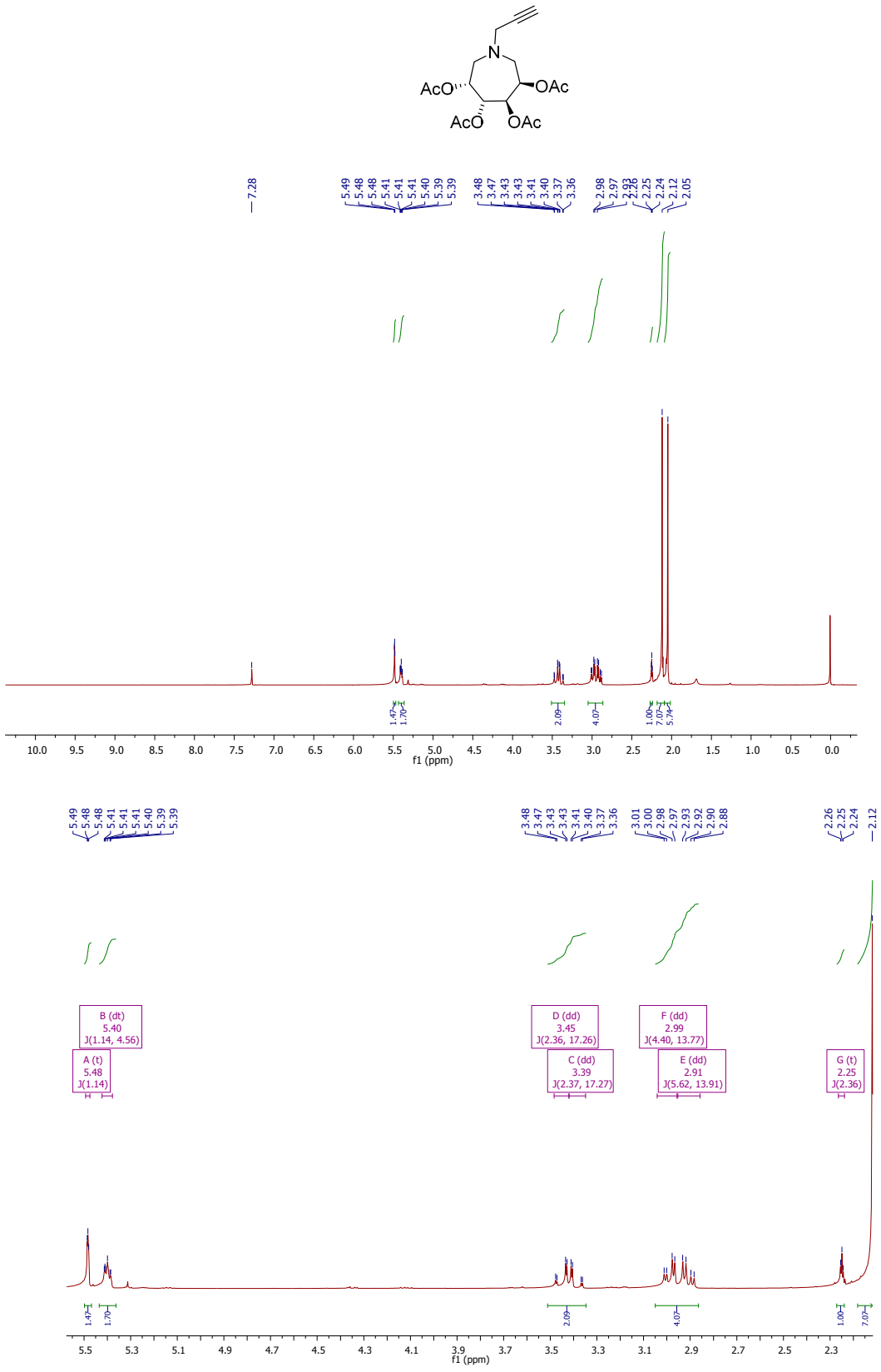


^{13}C NMR (100 MHz, CD_3OD)

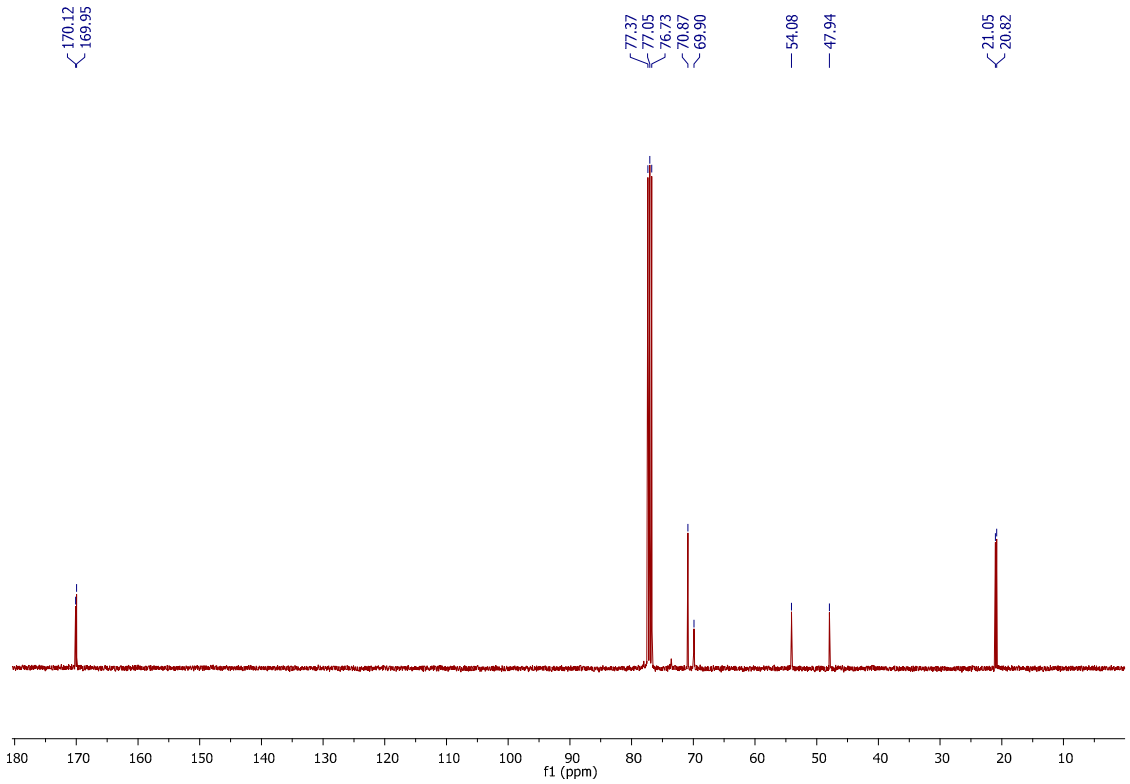


ESI HRMS: $[M+H]^+$ calcd for $C_{17}H_{24}NO_8$ 370.1496; found 370.1496.

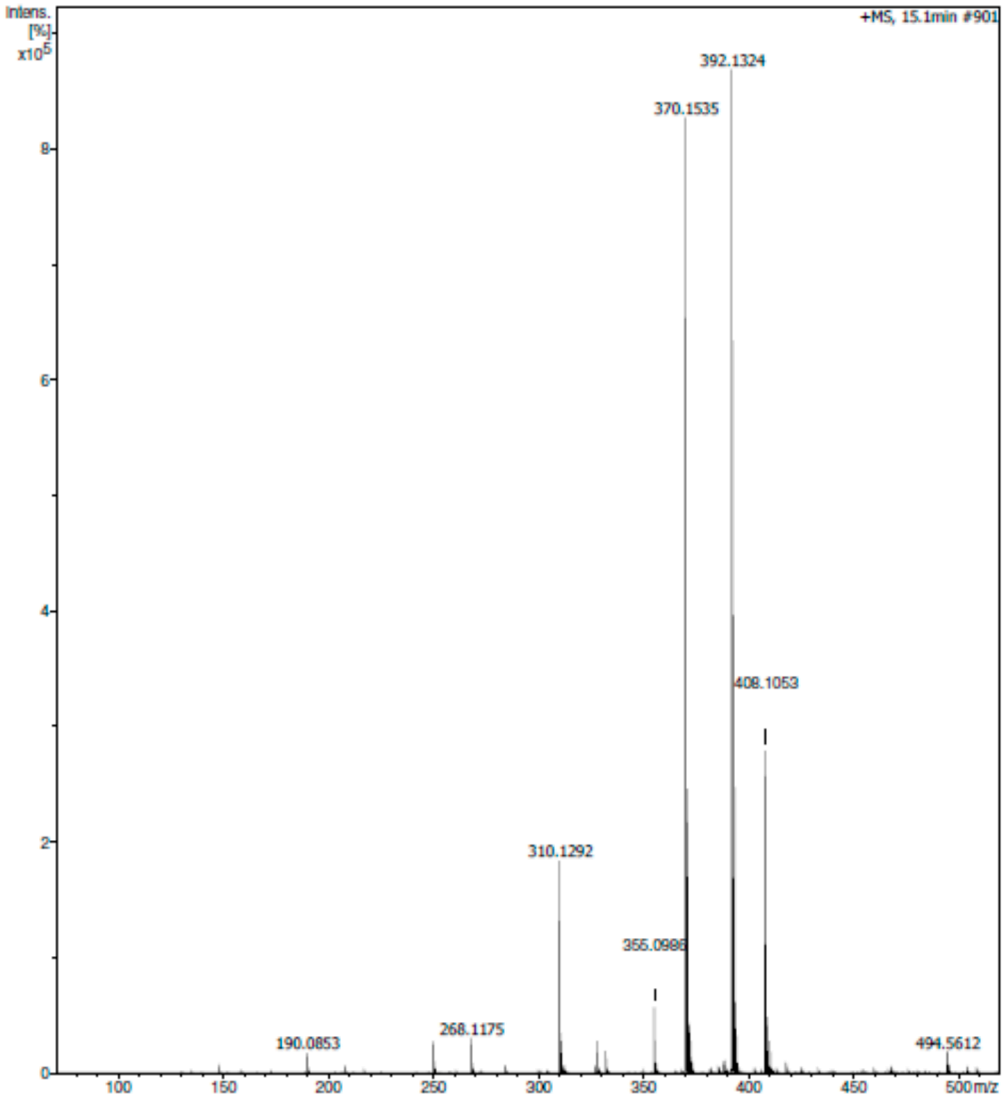
_N_-Propynyl-2,3,4,6-tetra-_O_-acetyl-1,6-dideoxy-1,6-imino-D-mannitol (30b):



^{1}H NMR (400 MHz, CD_3OD)

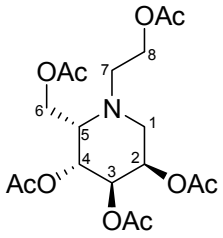


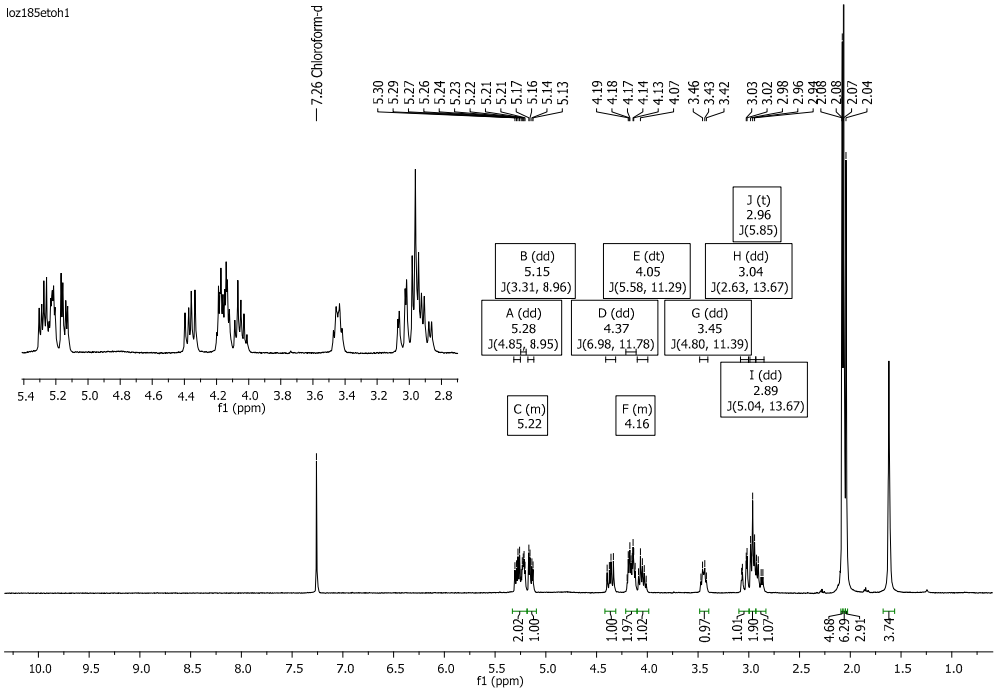
^{13}C NMR (100 MHz, CD_3OD)

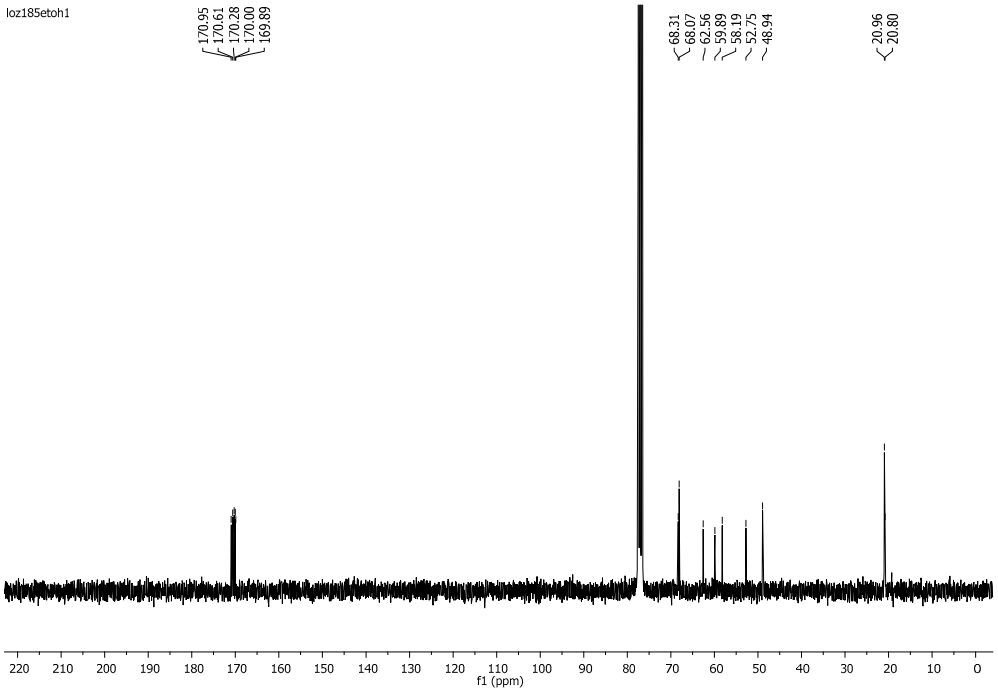


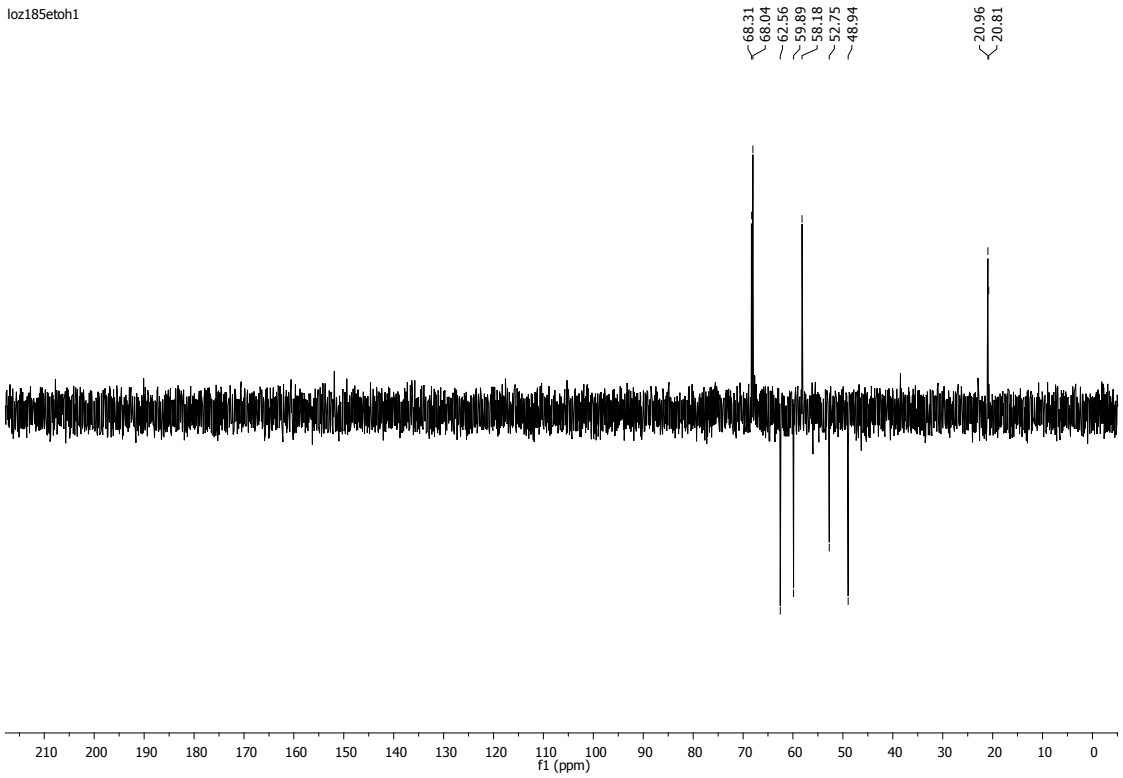
ESI HRMS: $[M+H]^+$ calcd for $C_{17}H_{24}NO_8$ 370.1496; found 370.1535.

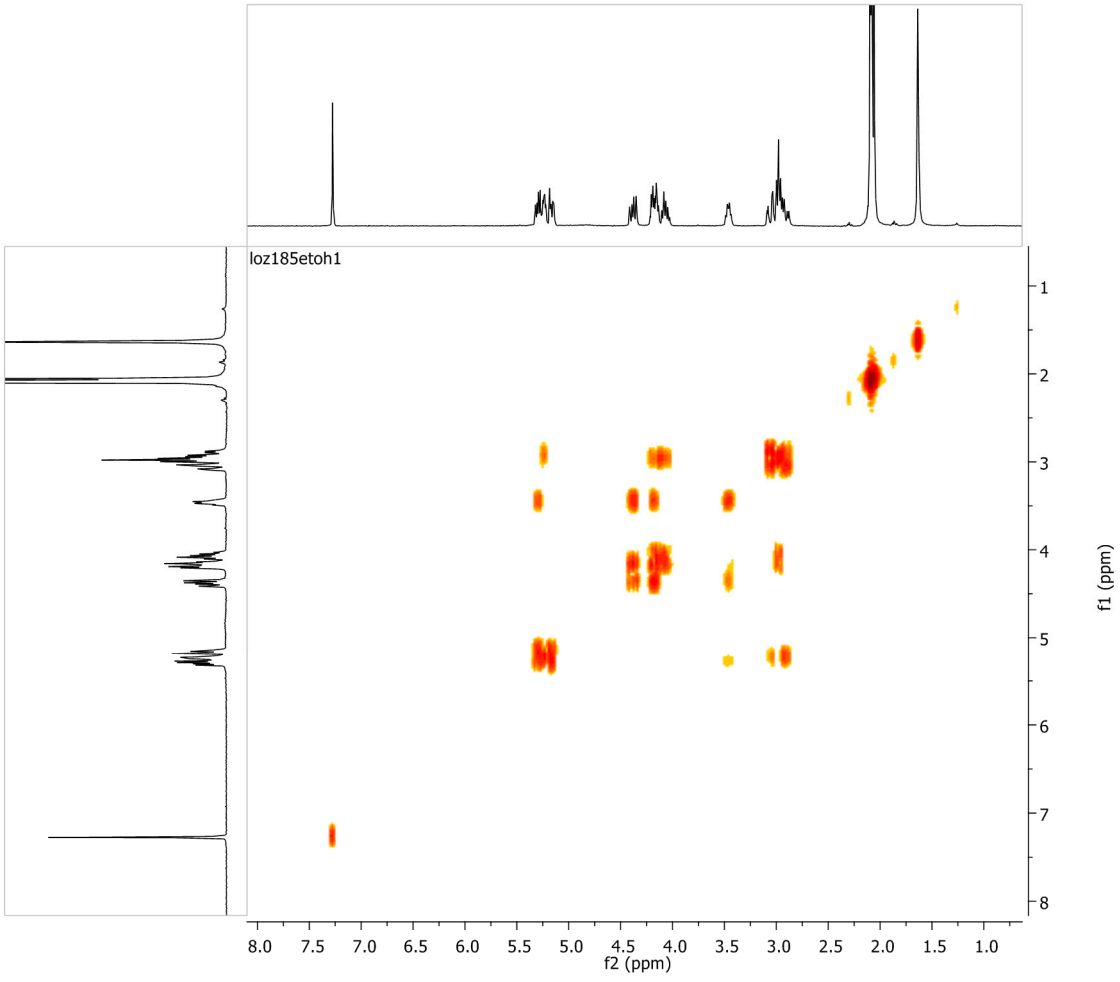
_N_-Acetoxyethyl-2,3,4,6-tetra-_O_-acetyl-1,5-dideoxy-1,5-imino-L-gulitol (31a):

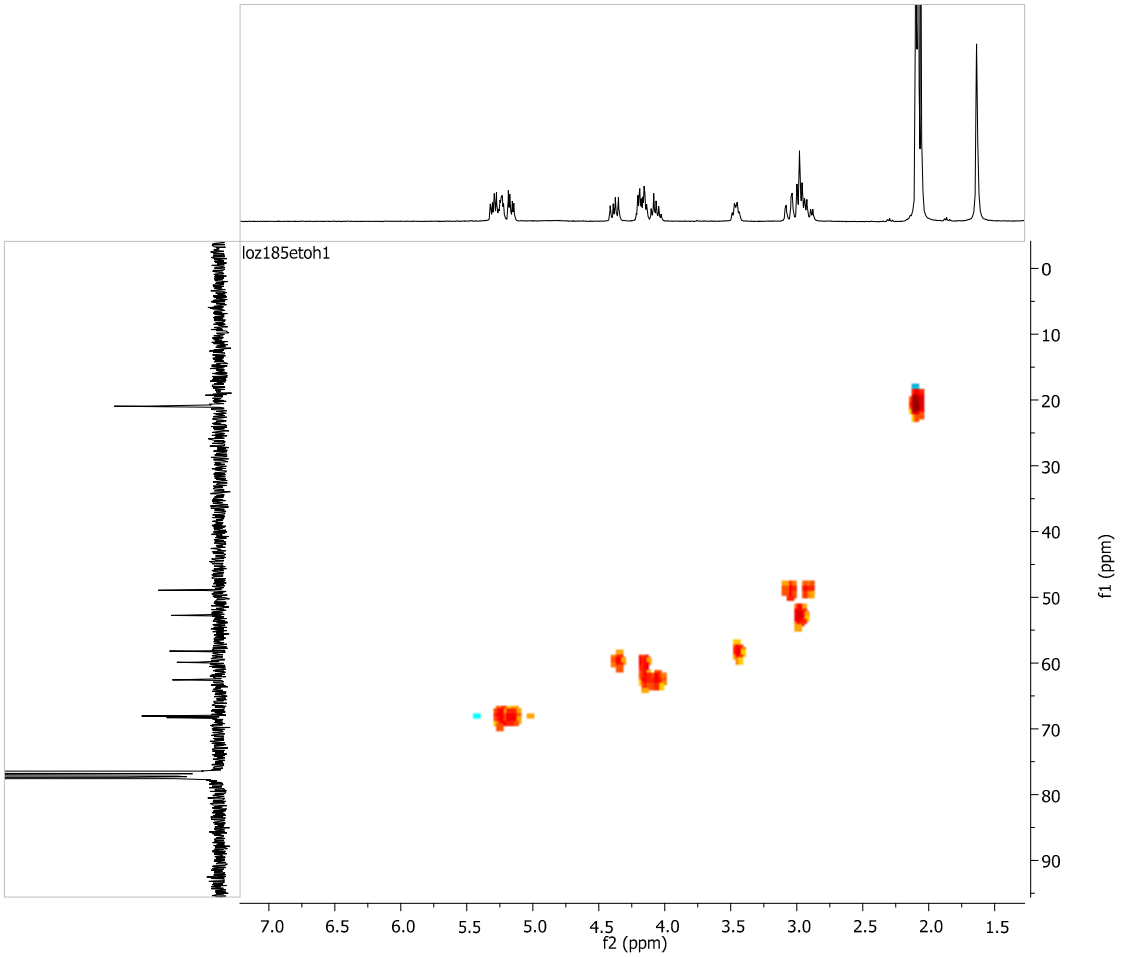




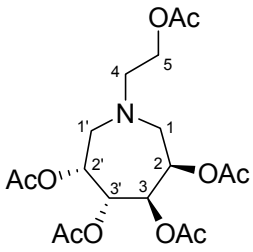


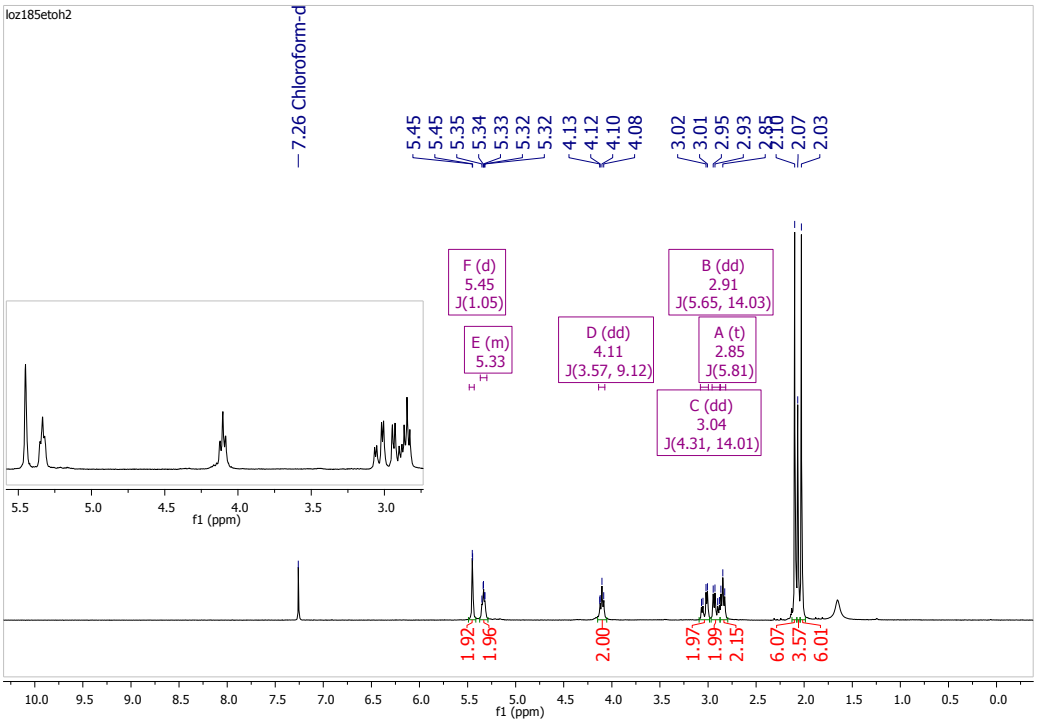

loz185etoh1
68.31
68.04
62.56
59.89
58.18
52.75
48.94
20.96
20.81
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

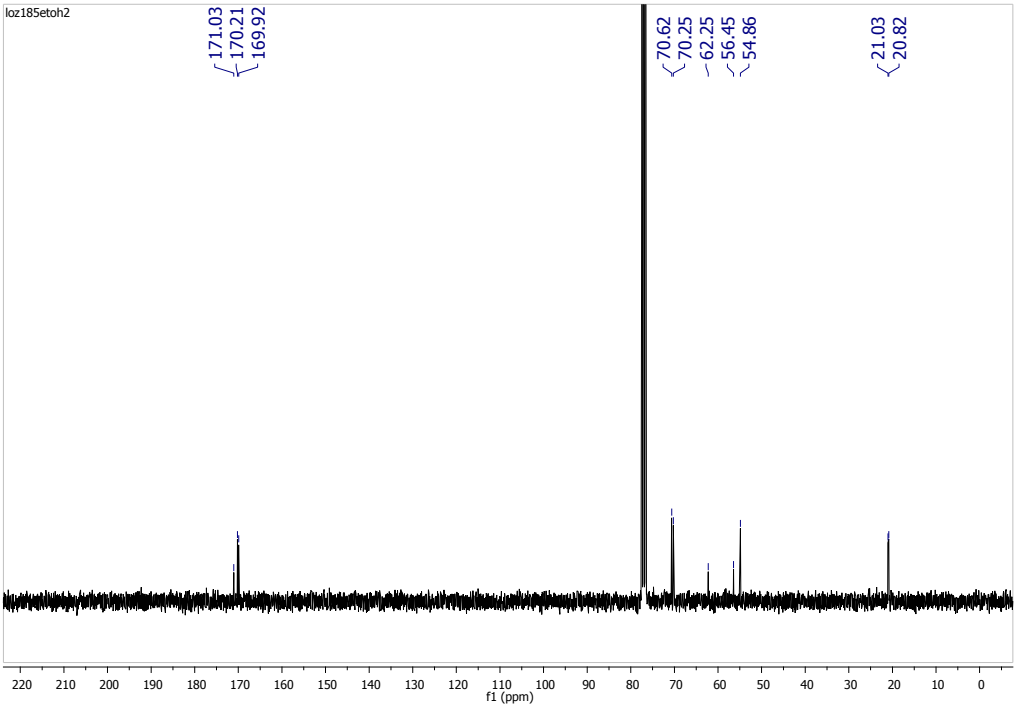

loz185etoh1
1
2
3
4
5
6
7
8
f1 (ppm)
8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0
f2 (ppm)

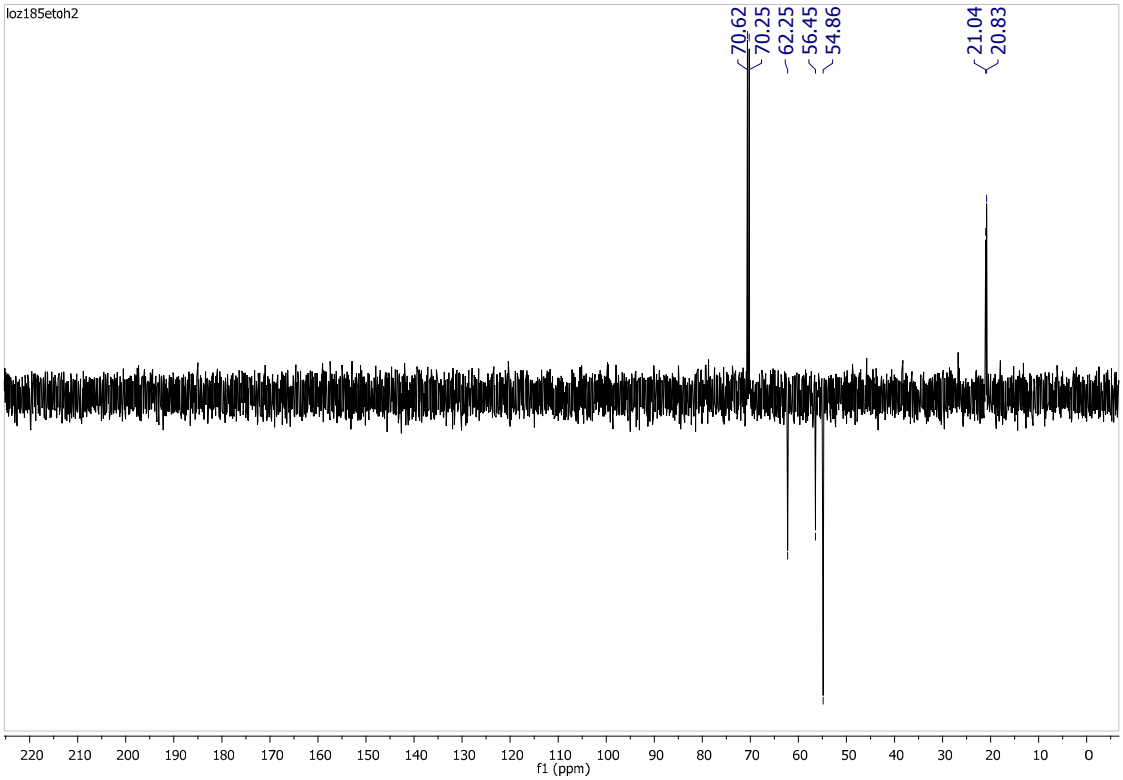

loz185etoh1
0
10
20
30
40
50
60
70
80
90
f1 (ppm)
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
f2 (ppm)

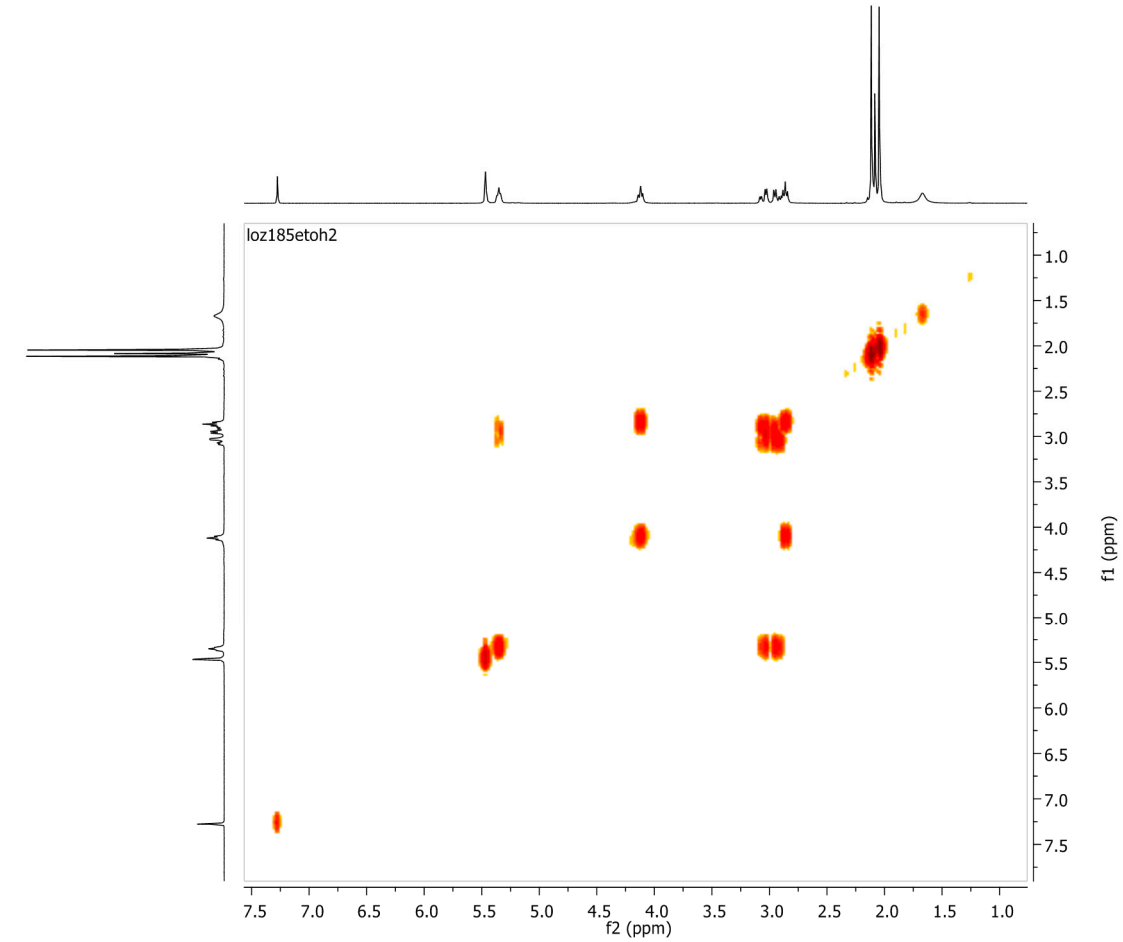
_N_-Acetoxyethyl-2,3,4,6-tetra-_O_-acetyl-1,6-dideoxy-1,6-imino-D-mannitol (31b):

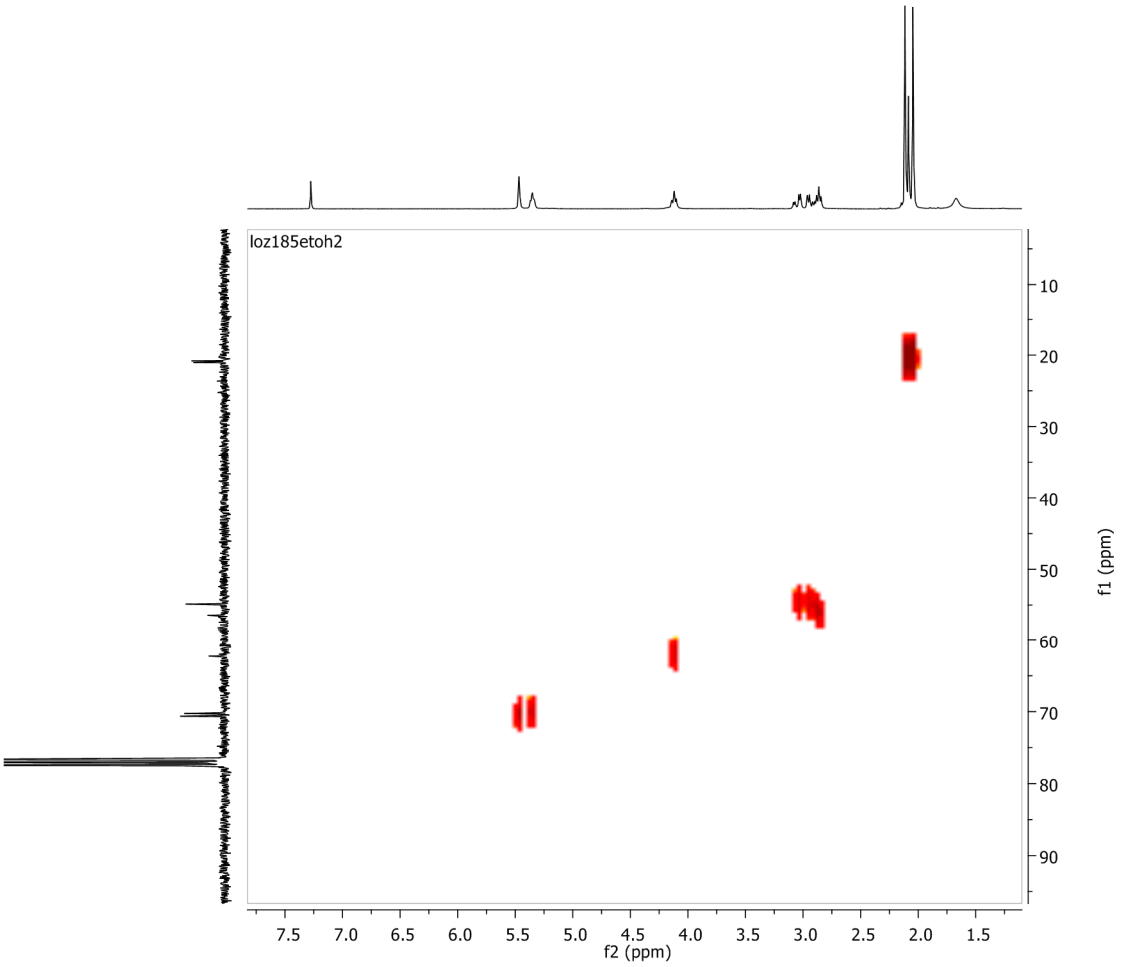




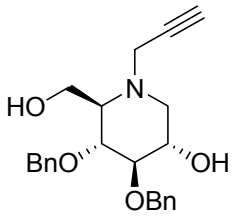


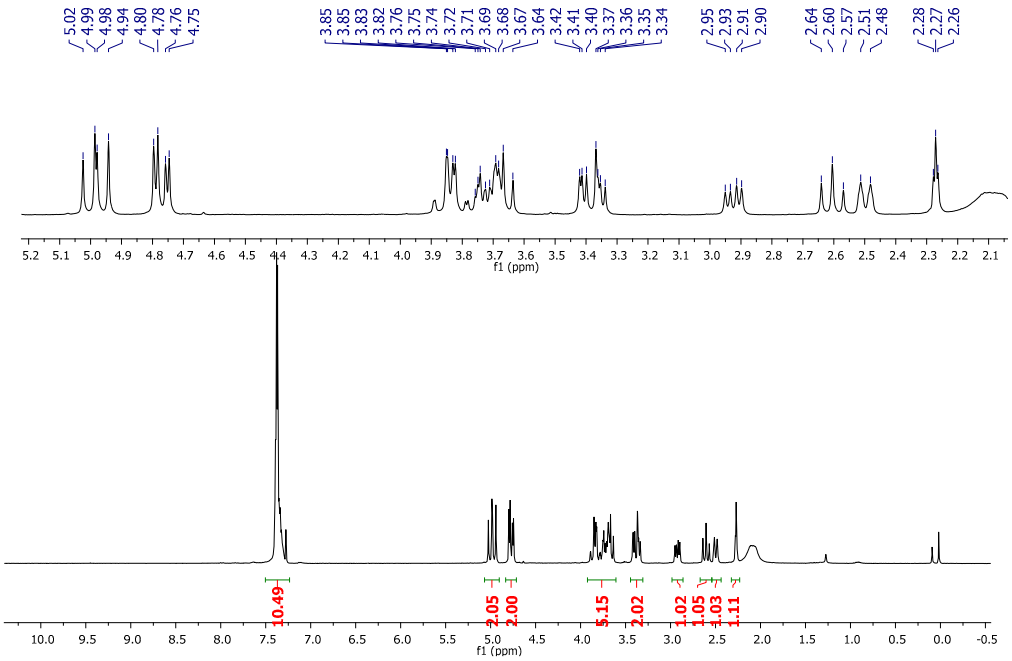

loz185etoh2
70.62
70.25
62.25
56.45
54.86
21.04
20.83
f1 (ppm)

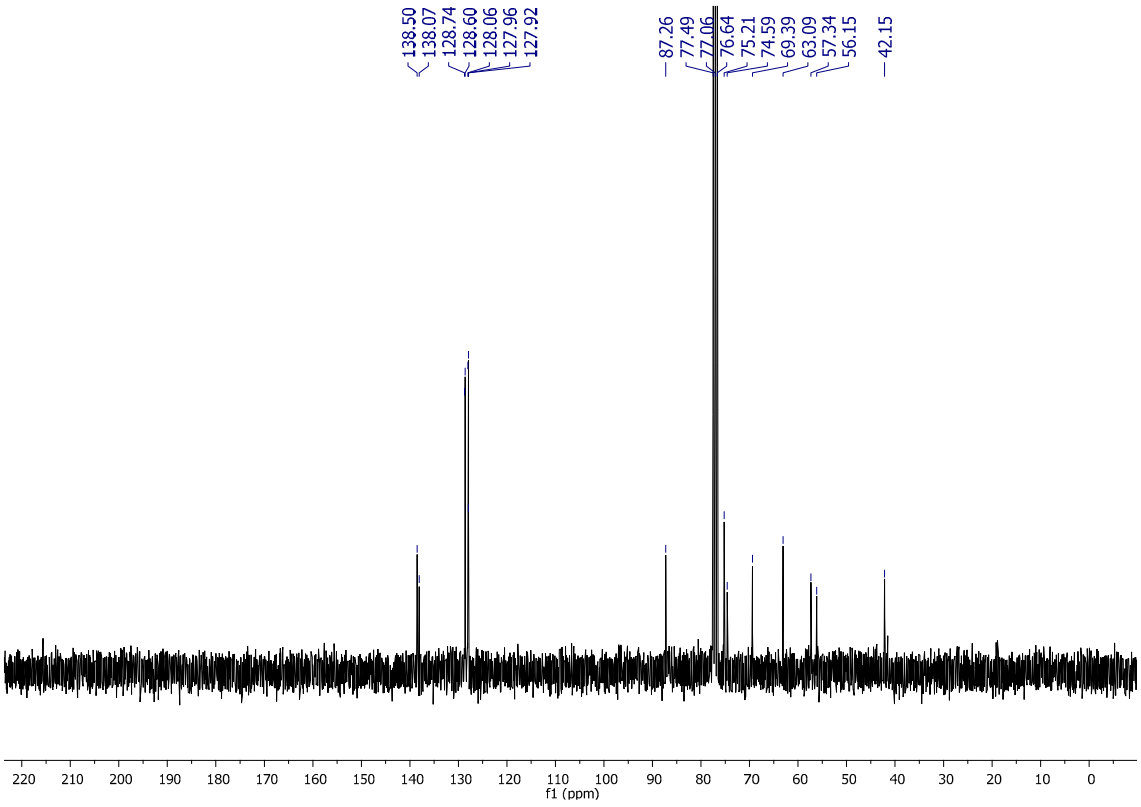

loz185etoh2
f2 (ppm)
f1 (ppm)

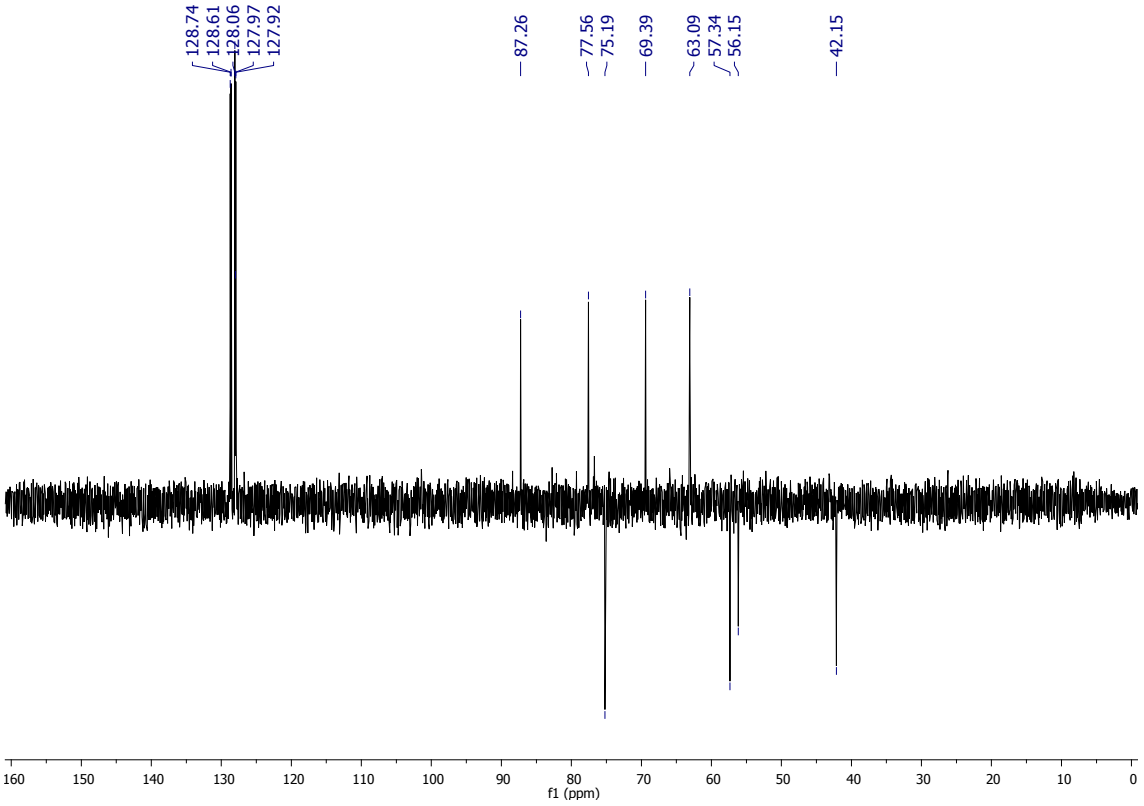

loz185etoh2
10
20
30
40
50
60
70
80
90
f1 (ppm)
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
f2 (ppm)

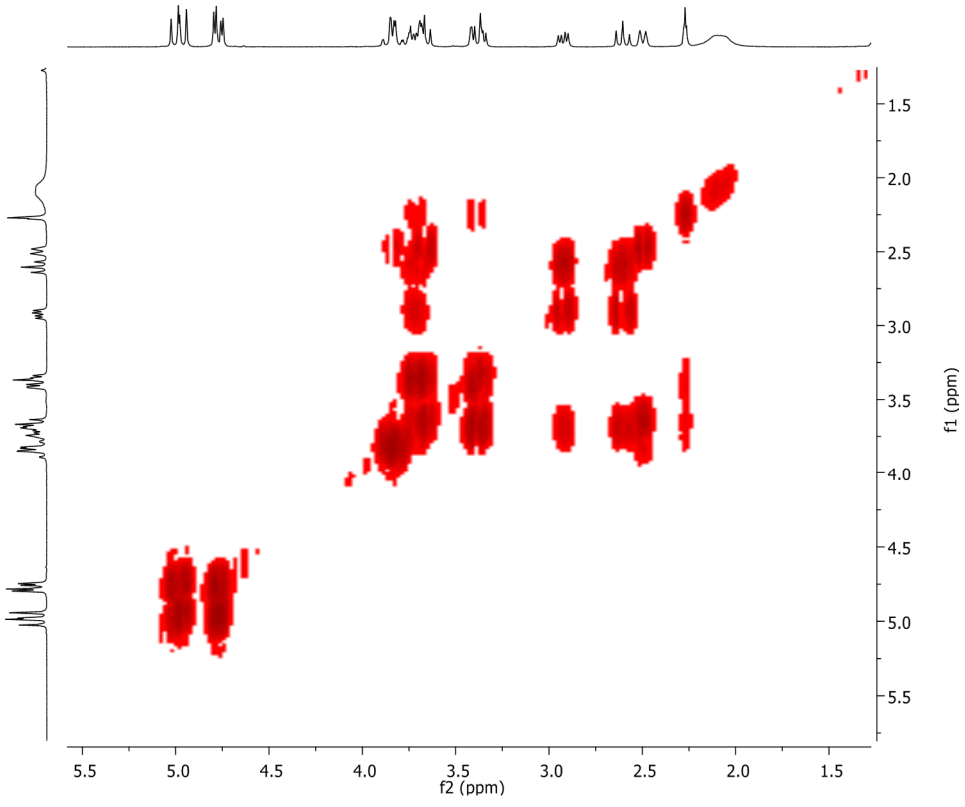
_N_-Propynyl-2,3,4,6-tetra-_O_-acetyl-1,5-dideoxy-1,5-imino-D-glucitol (36a):

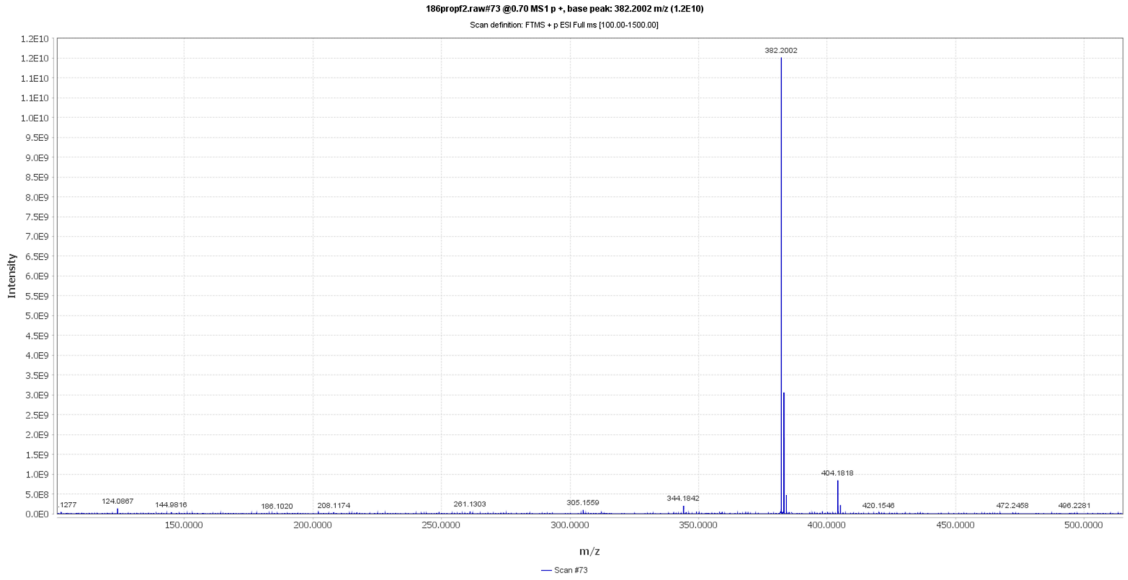






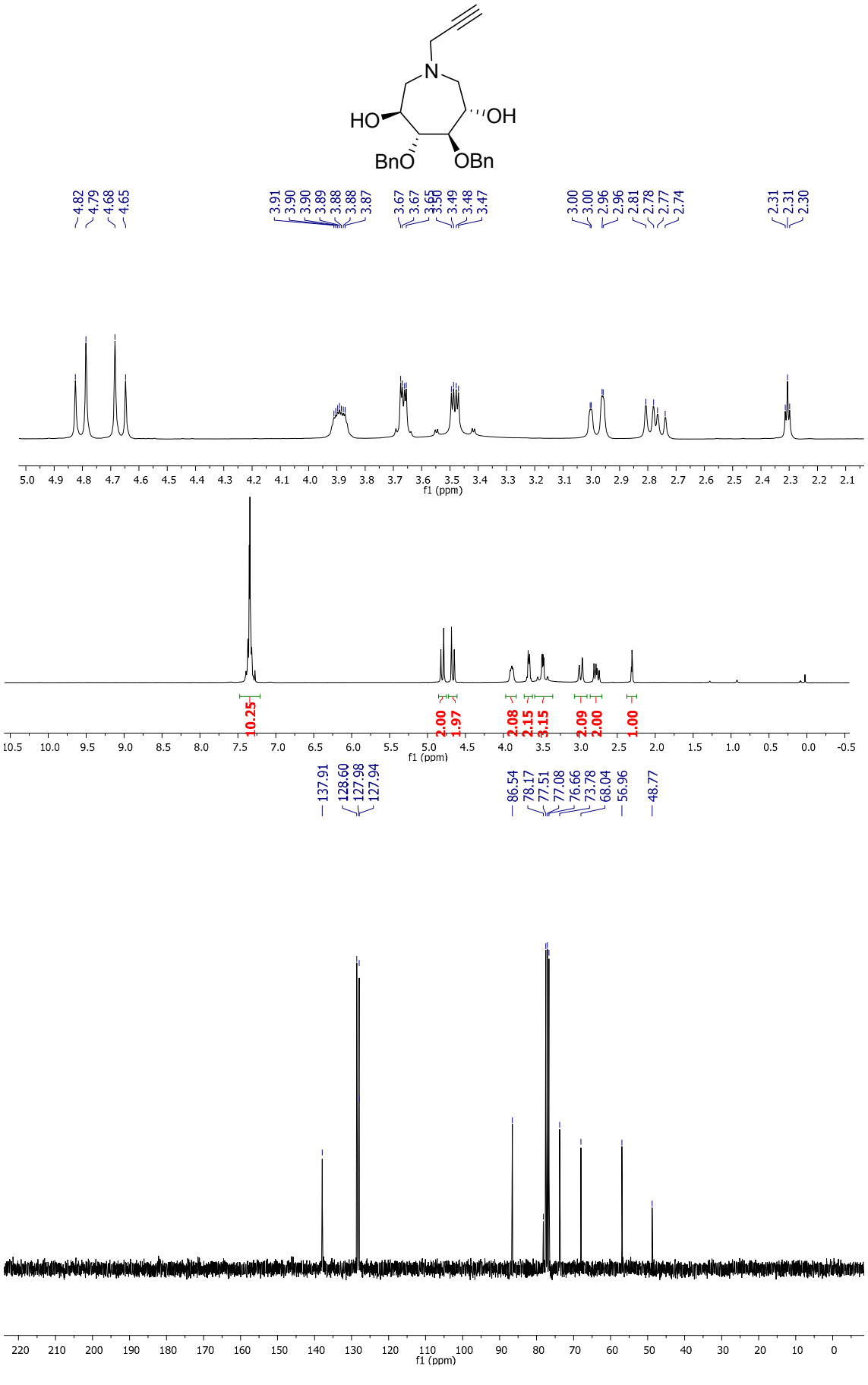

128.74
128.61
128.06
127.97
127.92
87.26
77.56
75.19
69.39
63.09
57.34
56.15
42.15
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

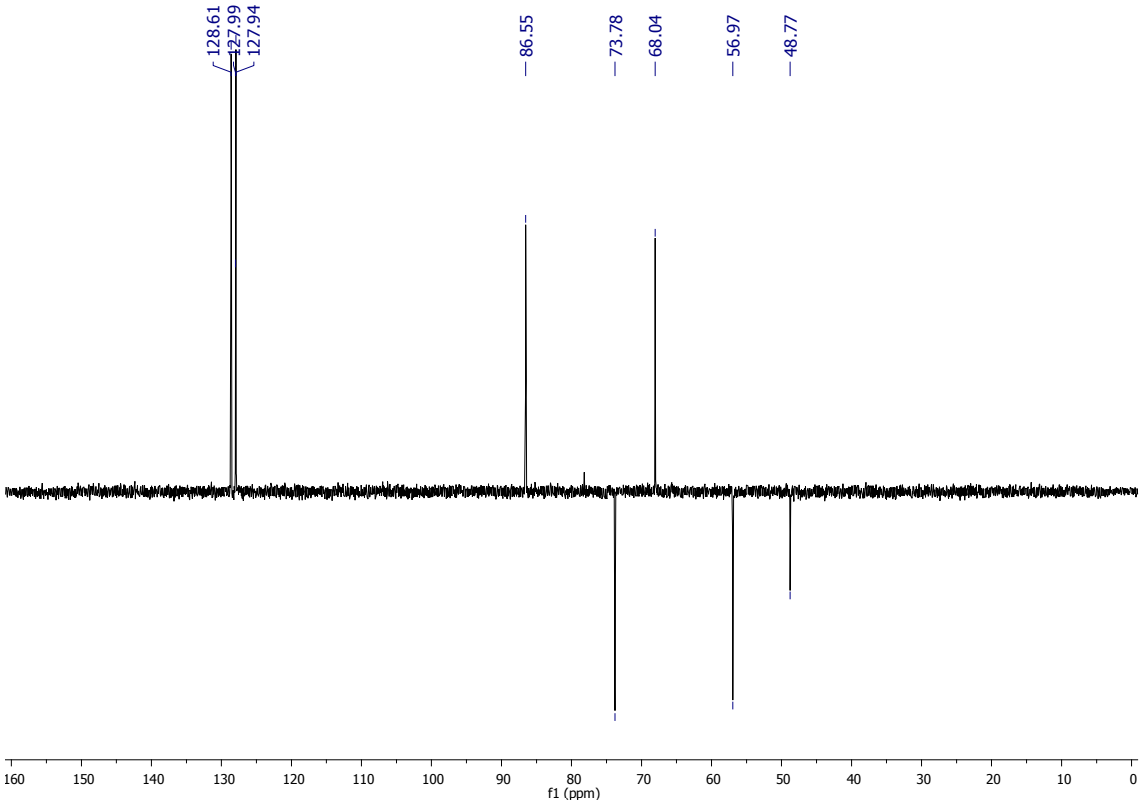

5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
f2 (ppm)
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
f1 (ppm)

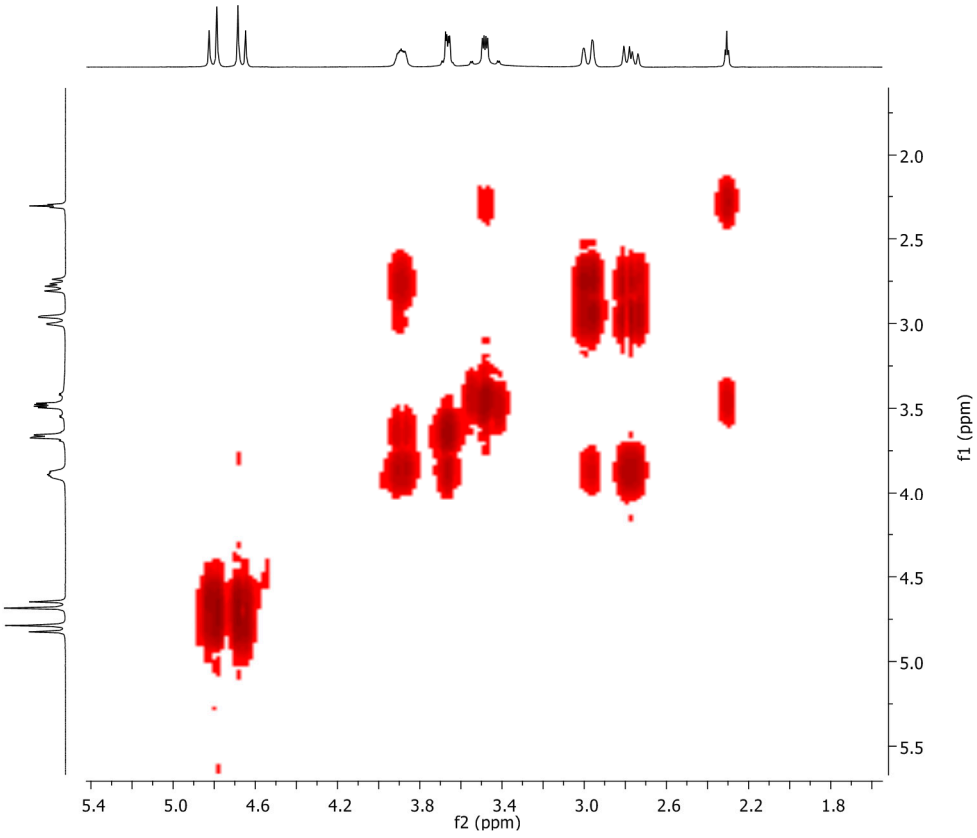


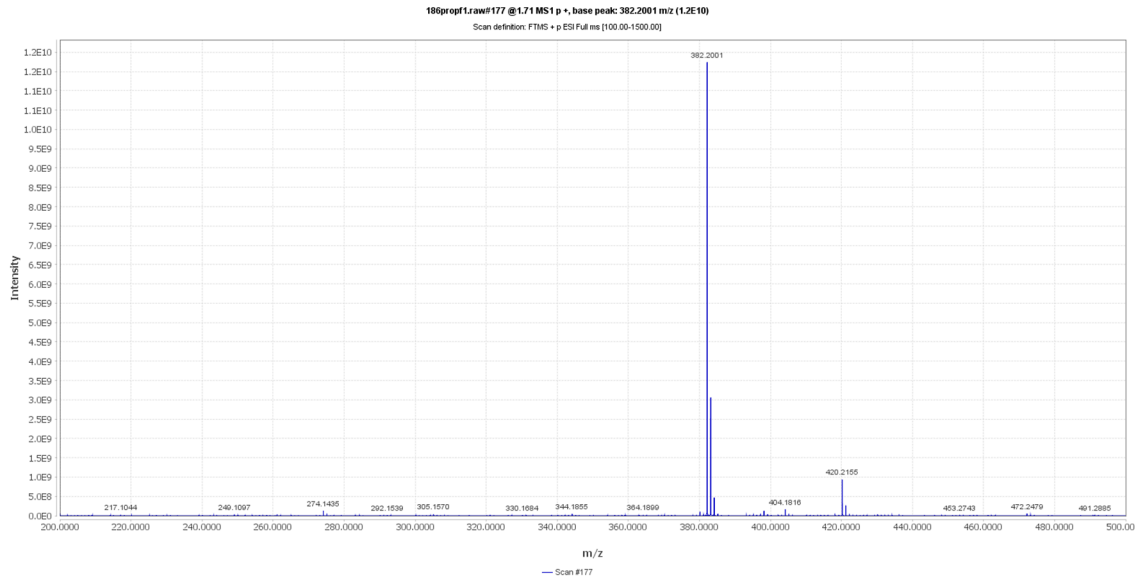
ESI HRMS: $[M+H]^+$ calcd for $C_{23}H_{28}NO_4$ 382.2013; found 382.2002

_N_-Propynyl-2,3,4,6-tetra-_O_-acetyl-1,6-dideoxy-1,6-imino-L-iditol (36b):



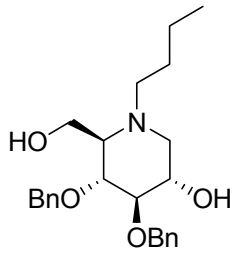

128.61
127.99
127.94
86.55
73.78
68.04
56.97
48.77
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

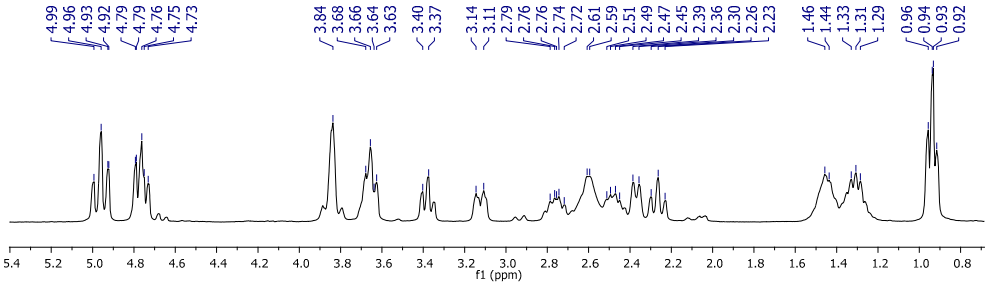

2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
f1 (ppm)
5.4
5.0
4.6
4.2
3.8
3.4
3.0
2.6
2.2
1.8
f2 (ppm)

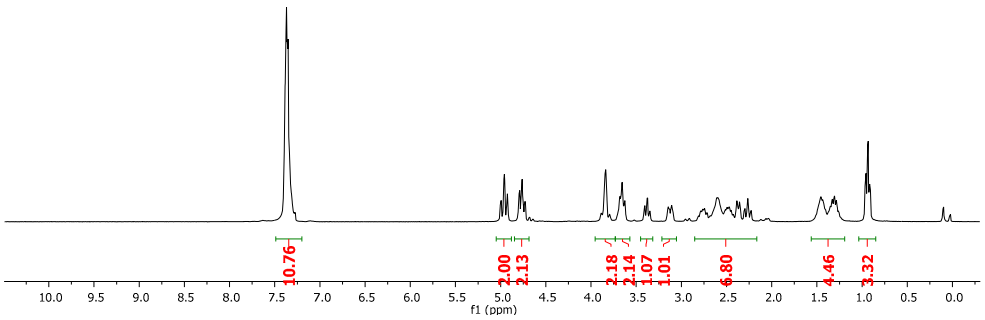


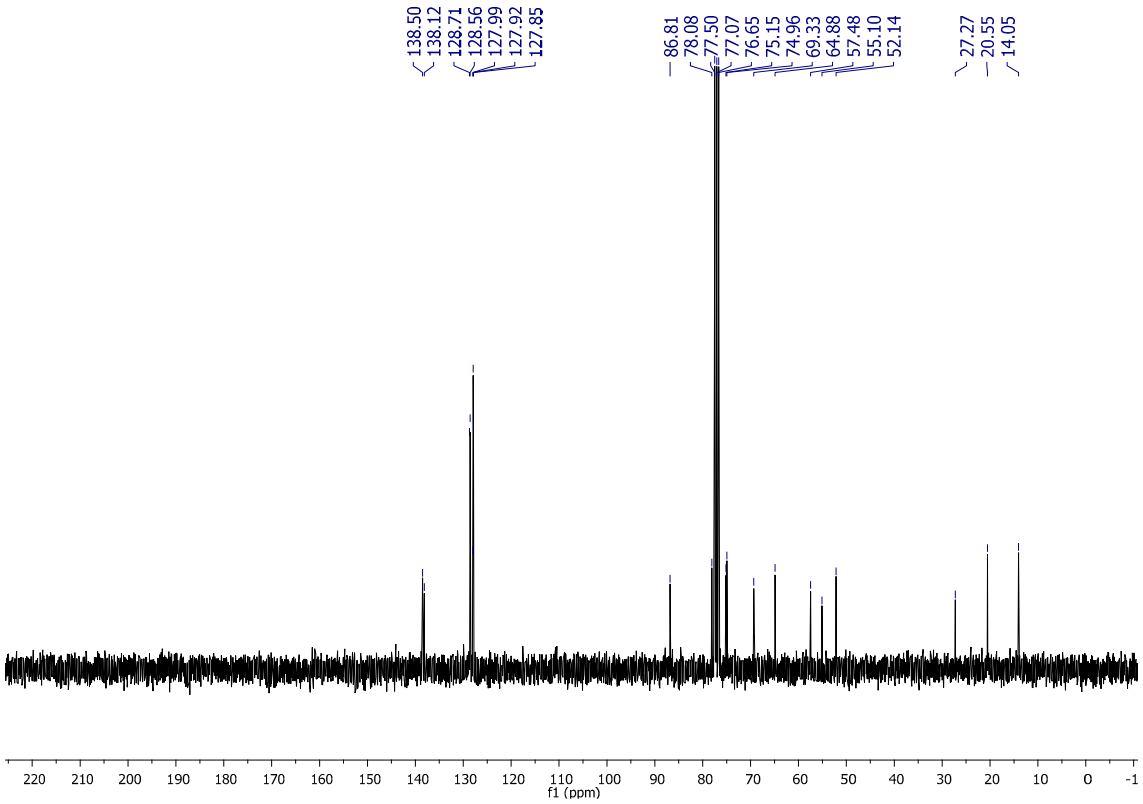
ESI HRMS: $[M+H]^+$ calcd for $C_{23}H_{28}NO_4$ 382.2013; found 382.2001

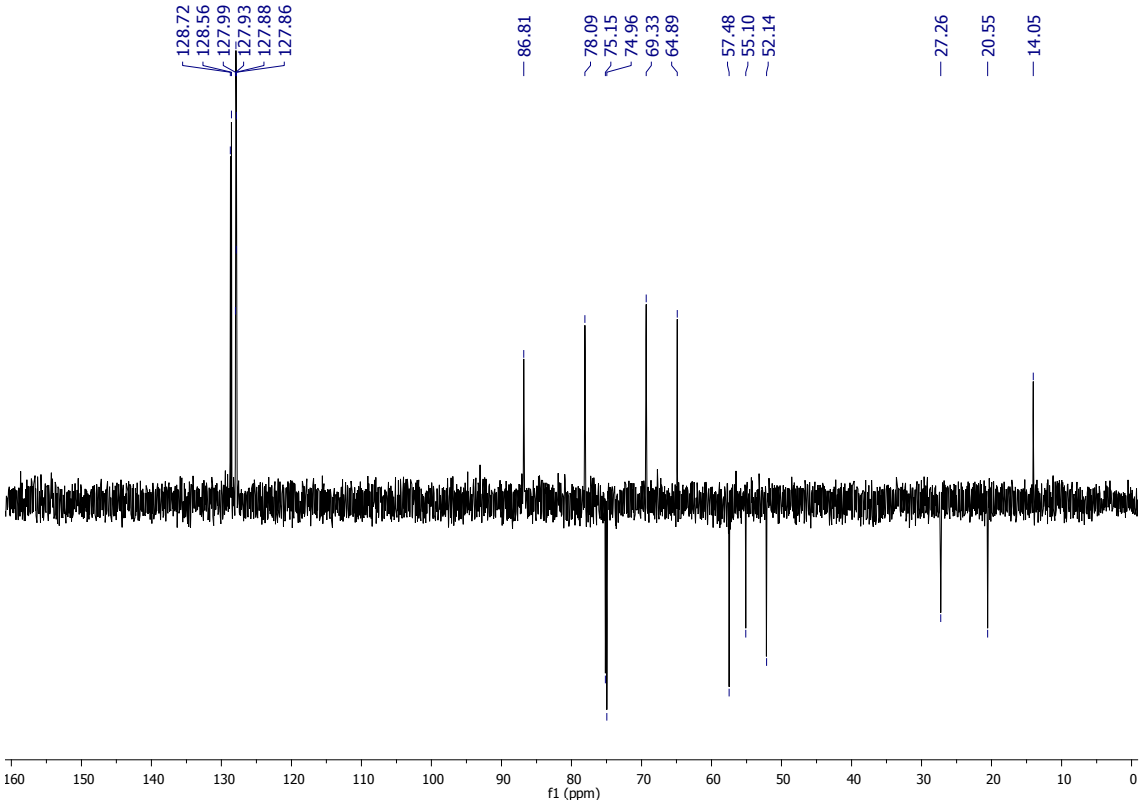
_N_-Butyl-2,3,4,6-tetra-_O_-acetyl-1,5-dideoxy-1,5-imino-D-glucitol (37a):

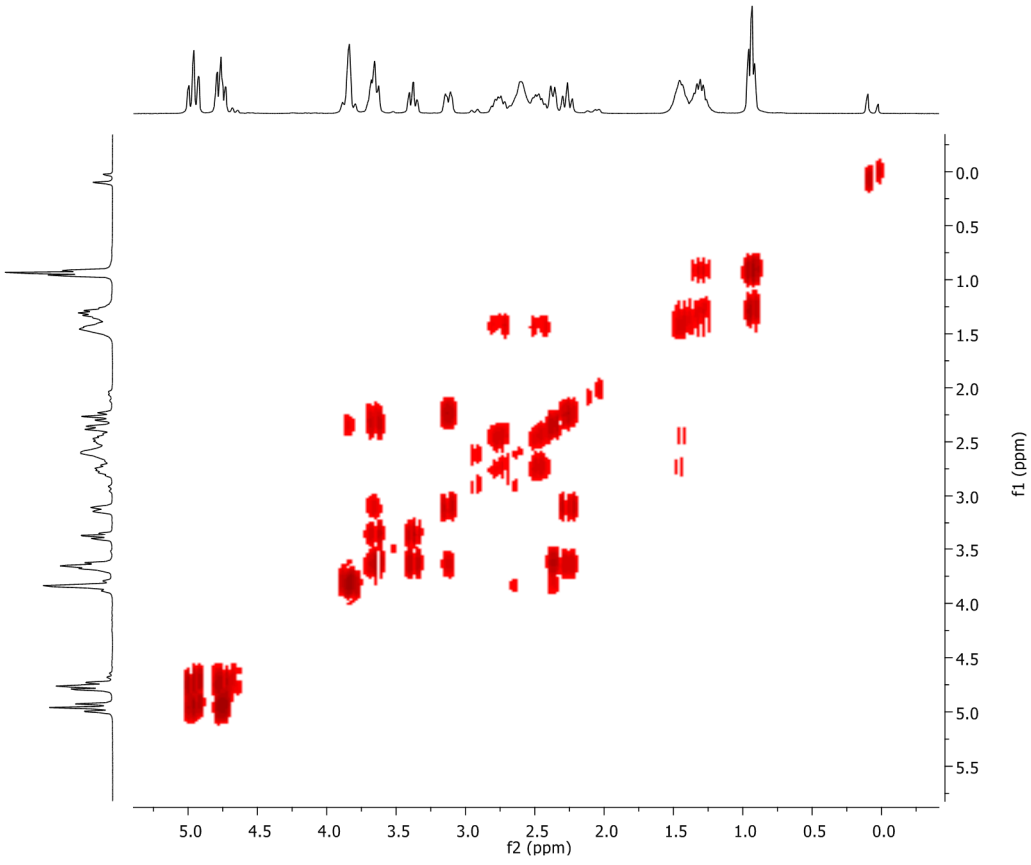


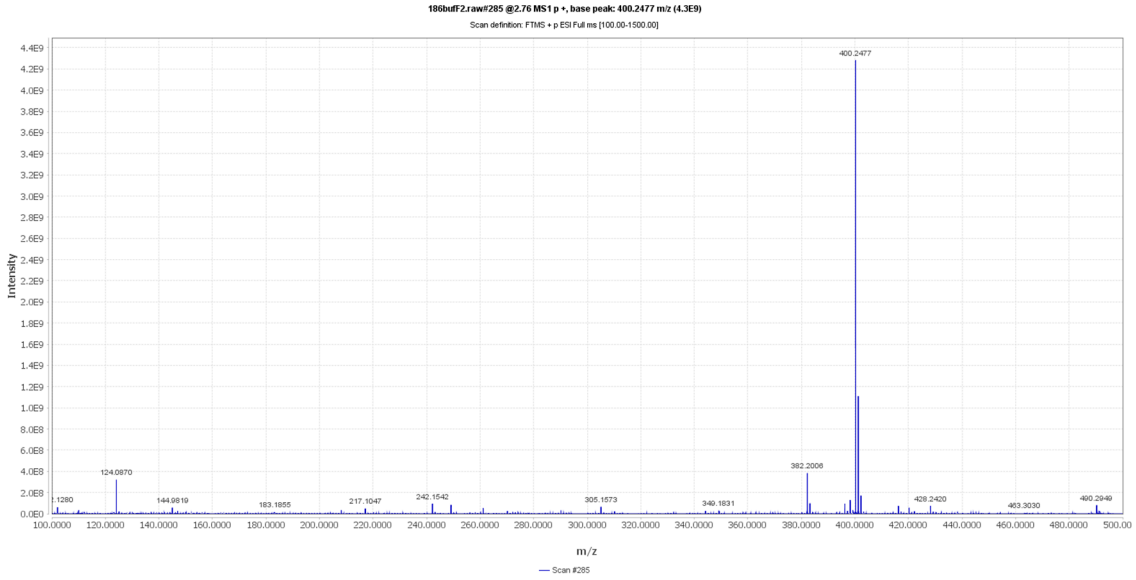






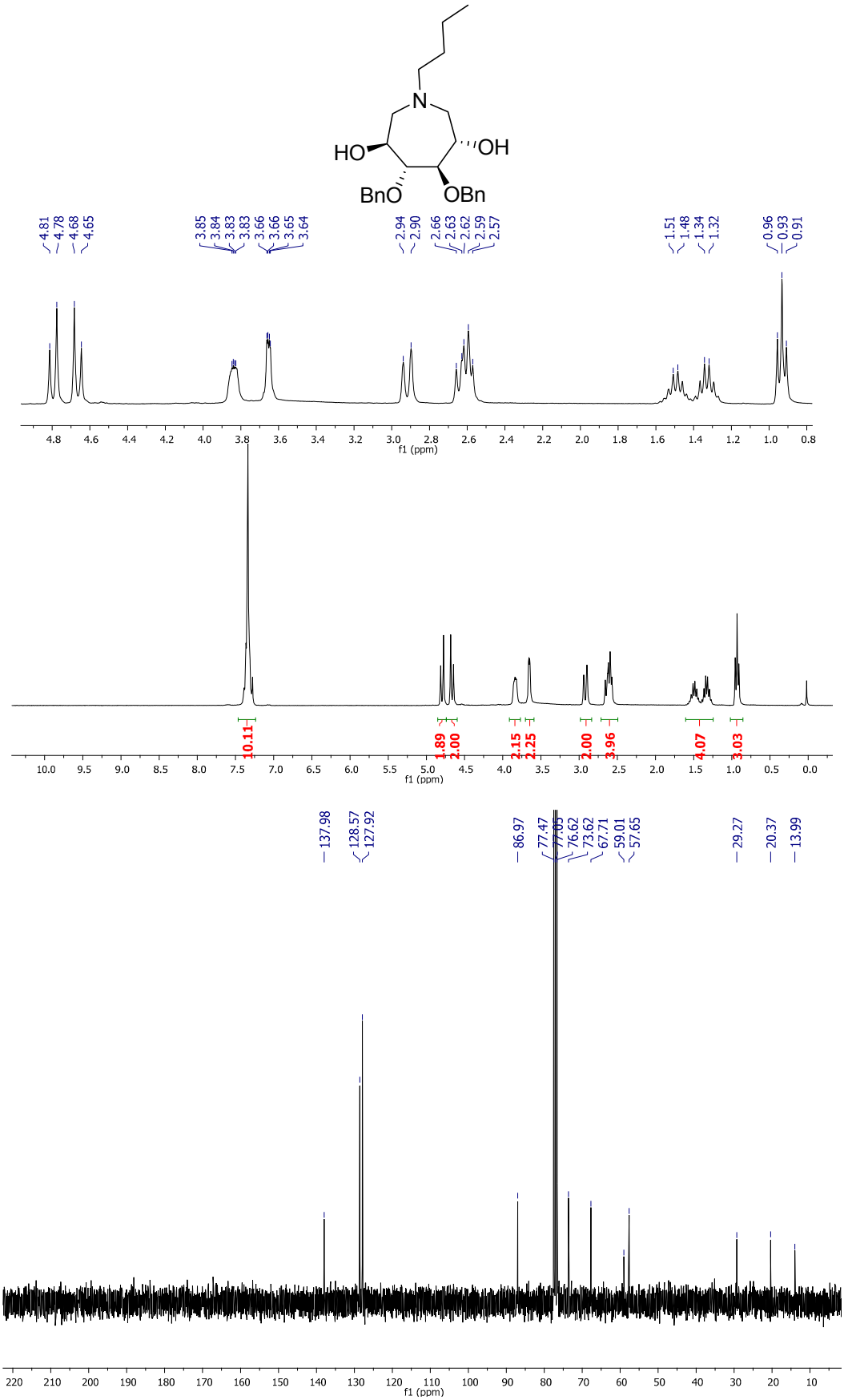

128.72
128.56
127.99
127.93
127.88
127.86
86.81
78.09
75.15
74.96
69.33
64.89
57.48
55.10
52.14
27.26
20.55
14.05
160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

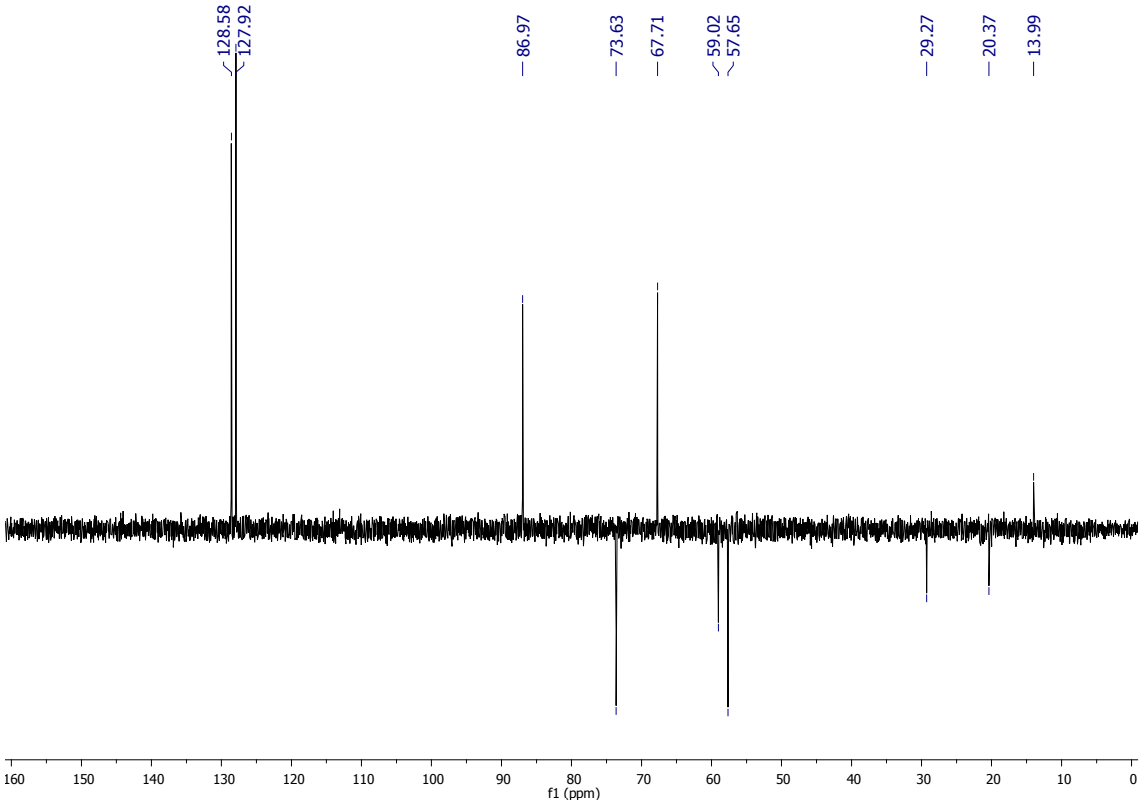

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5
f1 (ppm)
5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f2 (ppm)

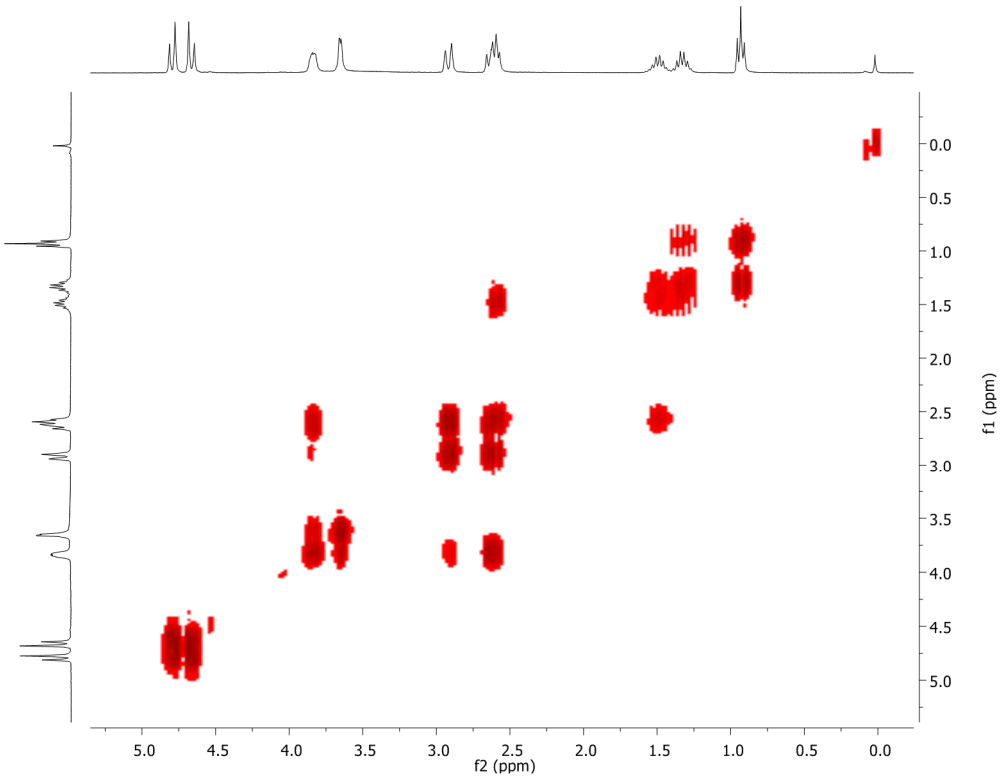


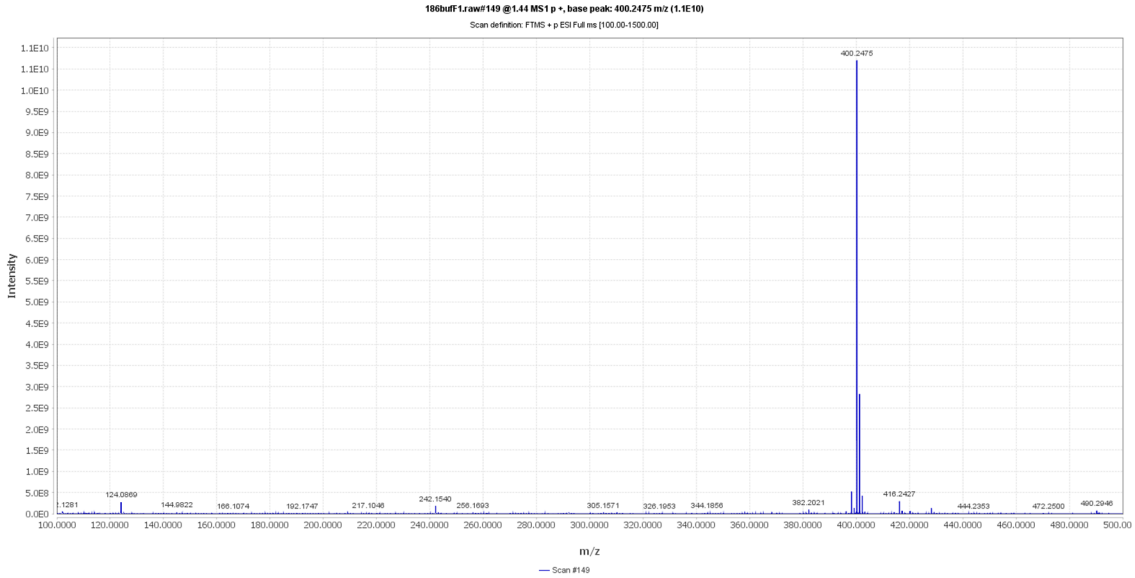
ESI HRMS: $[M+H]^+$ calcd for $C_{24}H_{34}NO_4$ 400.2483; found 400.2477

_N_-Butyl-2,3,4,6-tetra-_O_-acetyl-1,6-dideoxy-1,6-imino-L-iditol (37b):



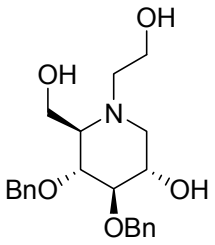

128.58
127.92
86.97
73.63
67.71
59.02
57.65
29.27
20.37
13.99
160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

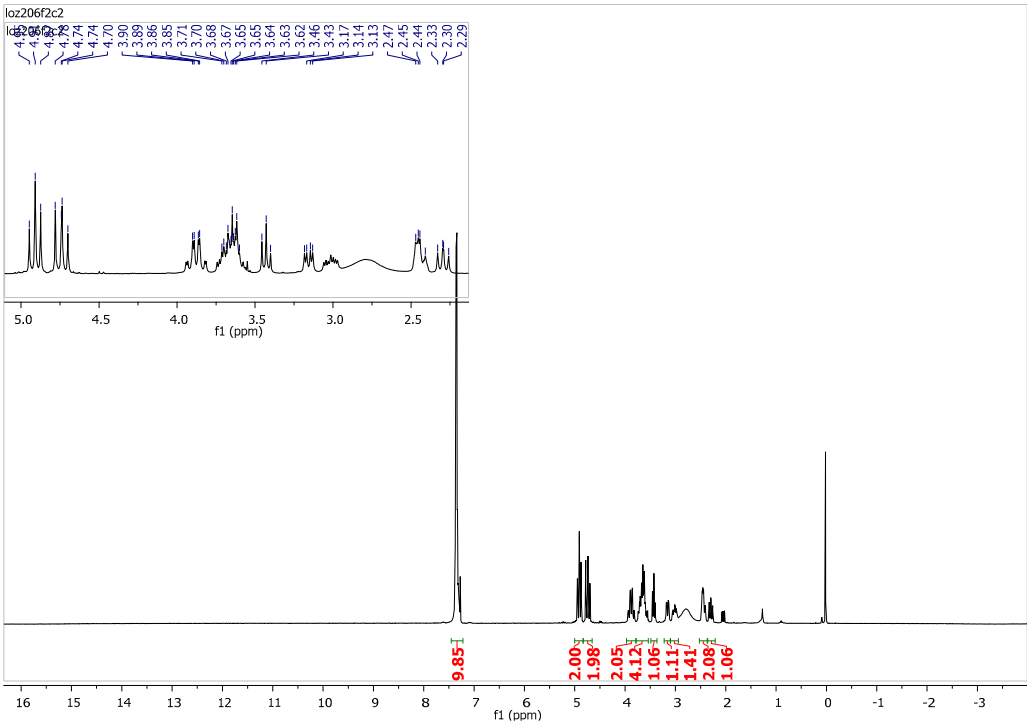

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
f1 (ppm)
5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f2 (ppm)

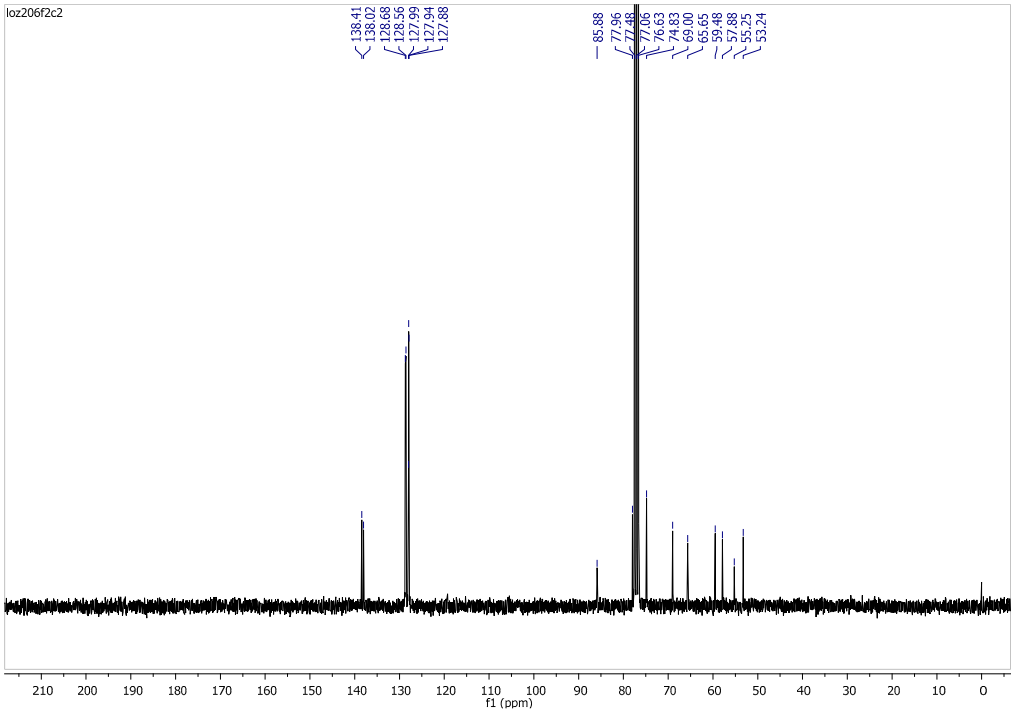


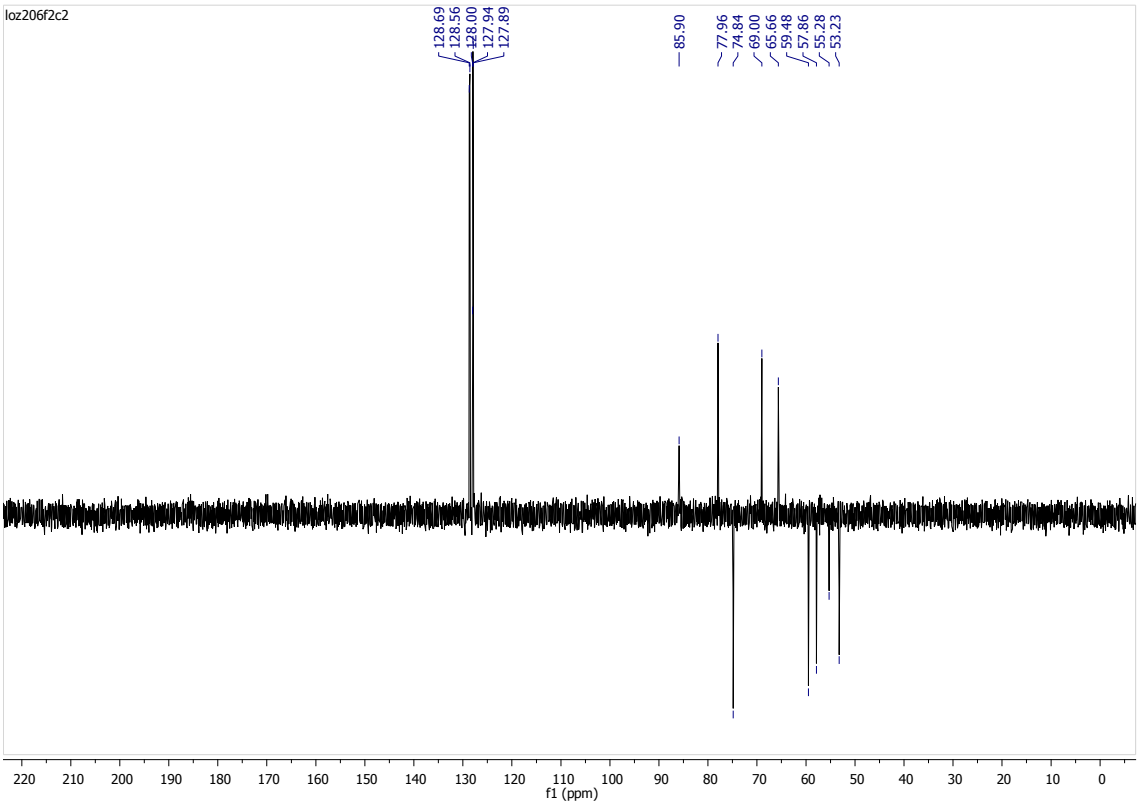
ESI HRMS: $[M+H]^+$ calcd for $C_{24}H_{34}NO_4$ 400.2483; found 400.2475

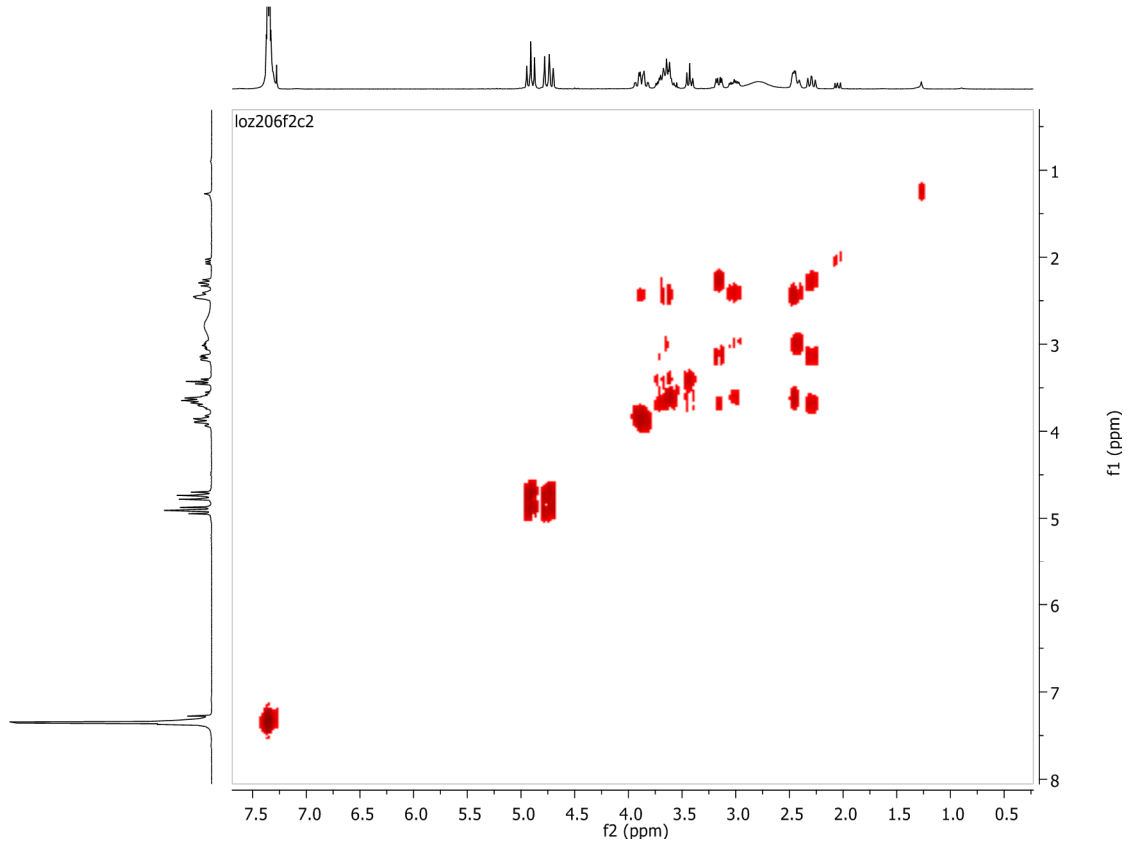
_N_-Hydroxyethyl-2,3,4,6-tetra-_O_-acetyl-1,5-dideoxy-1,5-imino-D-glucitol (38a):

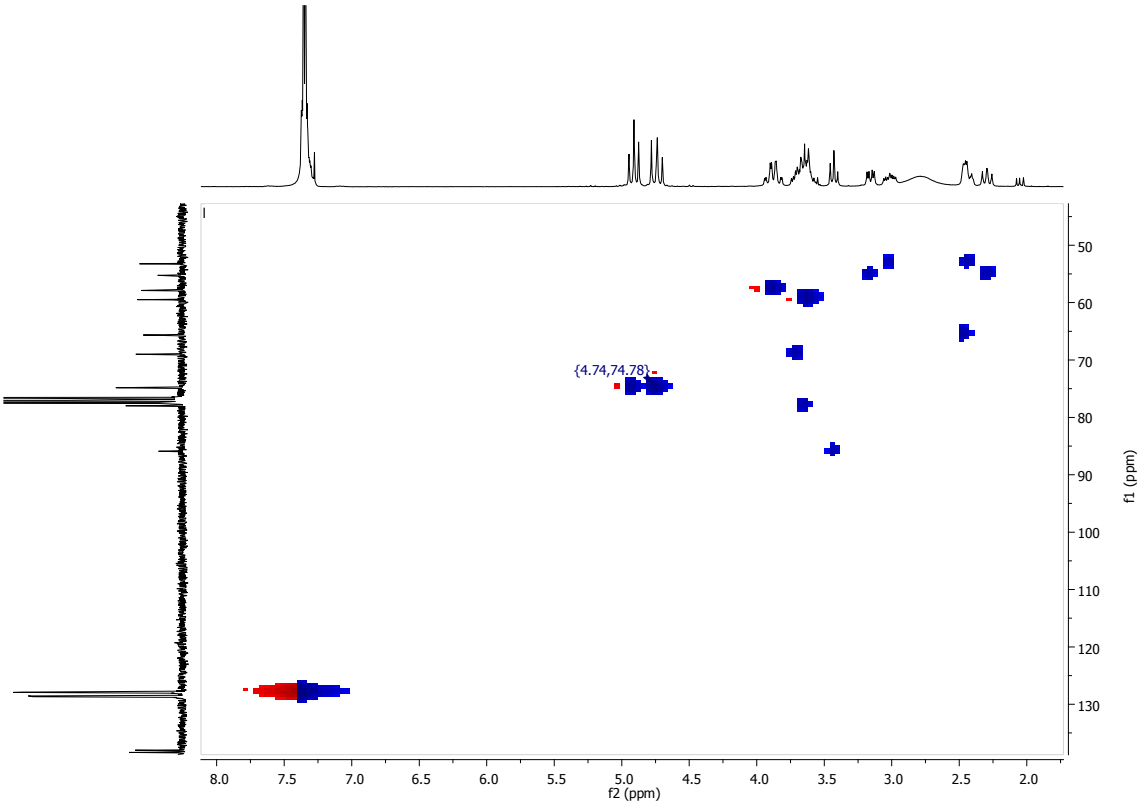


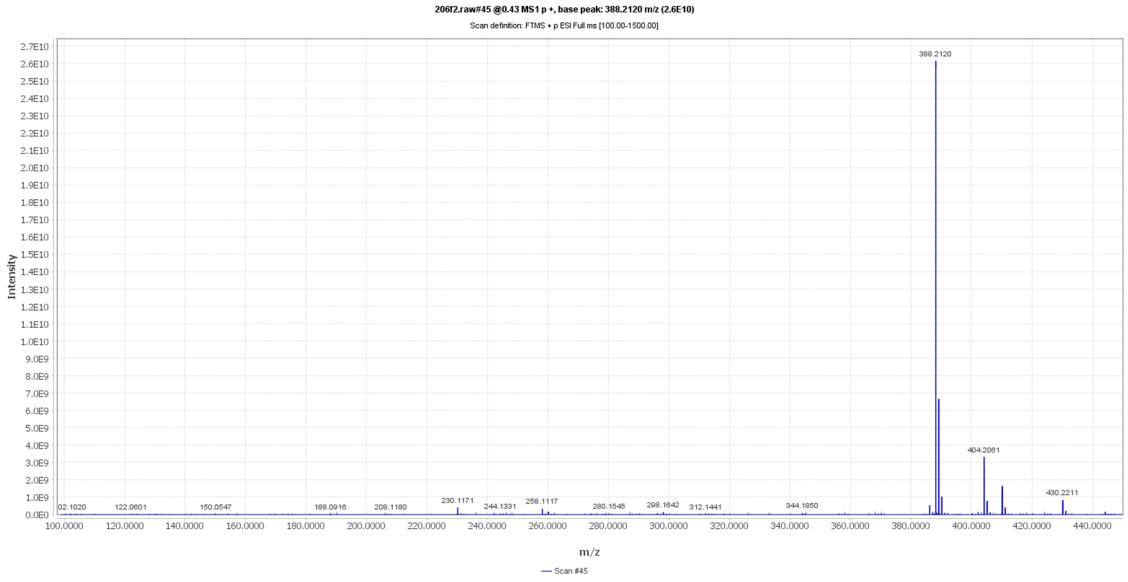





loz206f2c2
128.69
128.56
128.00
127.94
127.89
85.90
77.96
74.84
69.00
65.66
59.48
57.86
55.28
53.23
220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

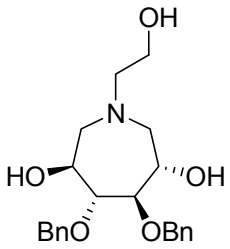

loz206f2c2
1
2
3
4
5
6
7
8
f1 (ppm)
7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5
f2 (ppm)

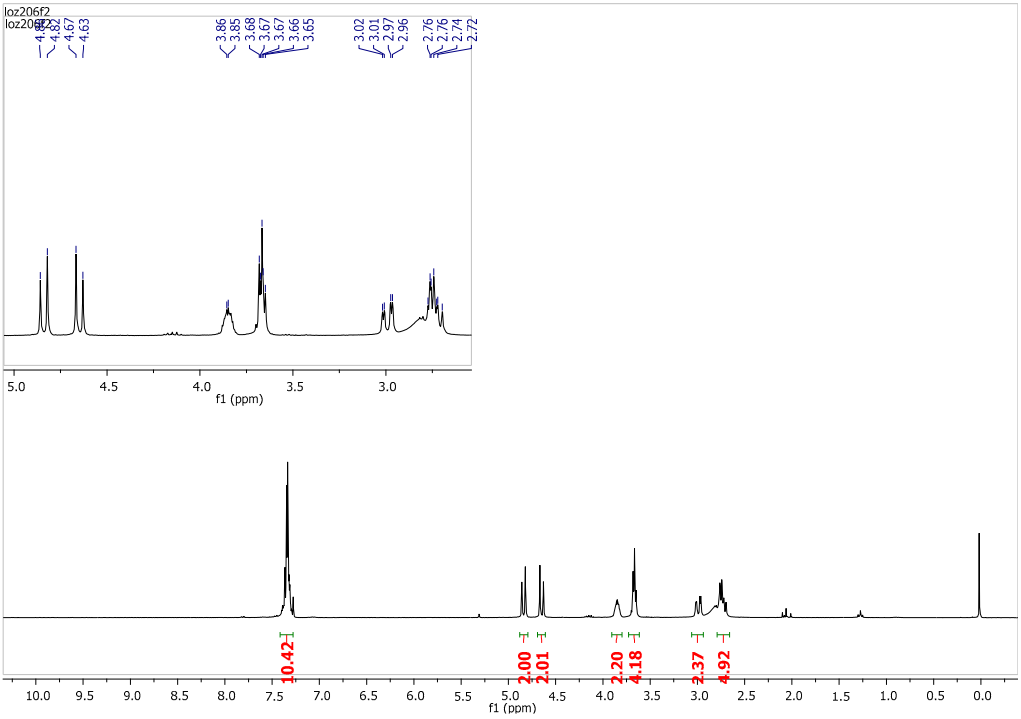


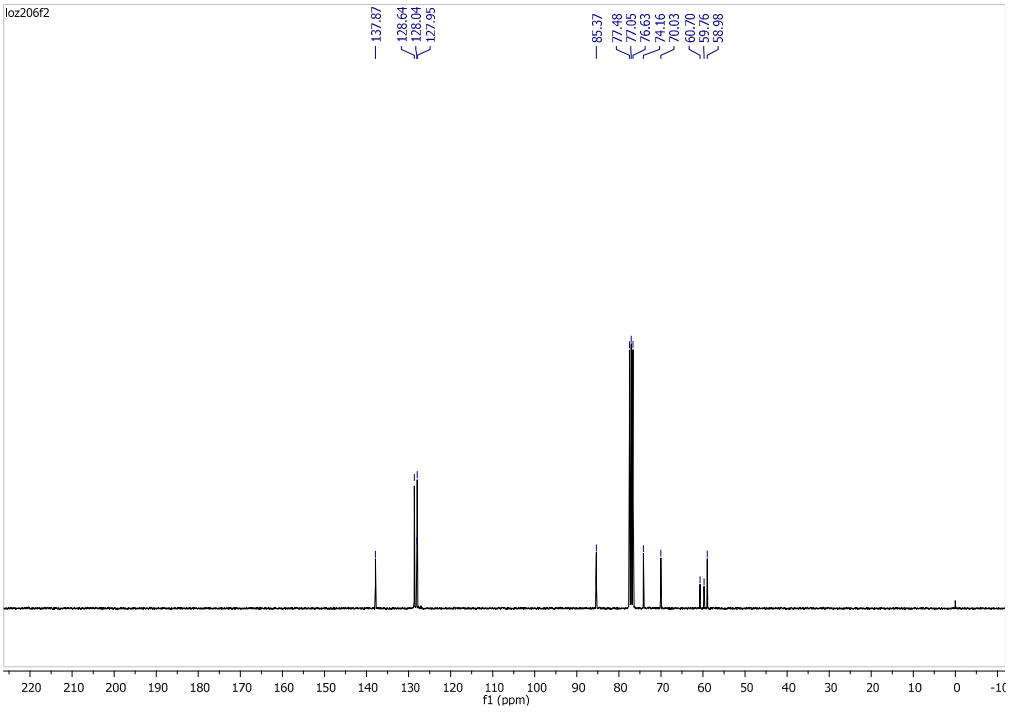


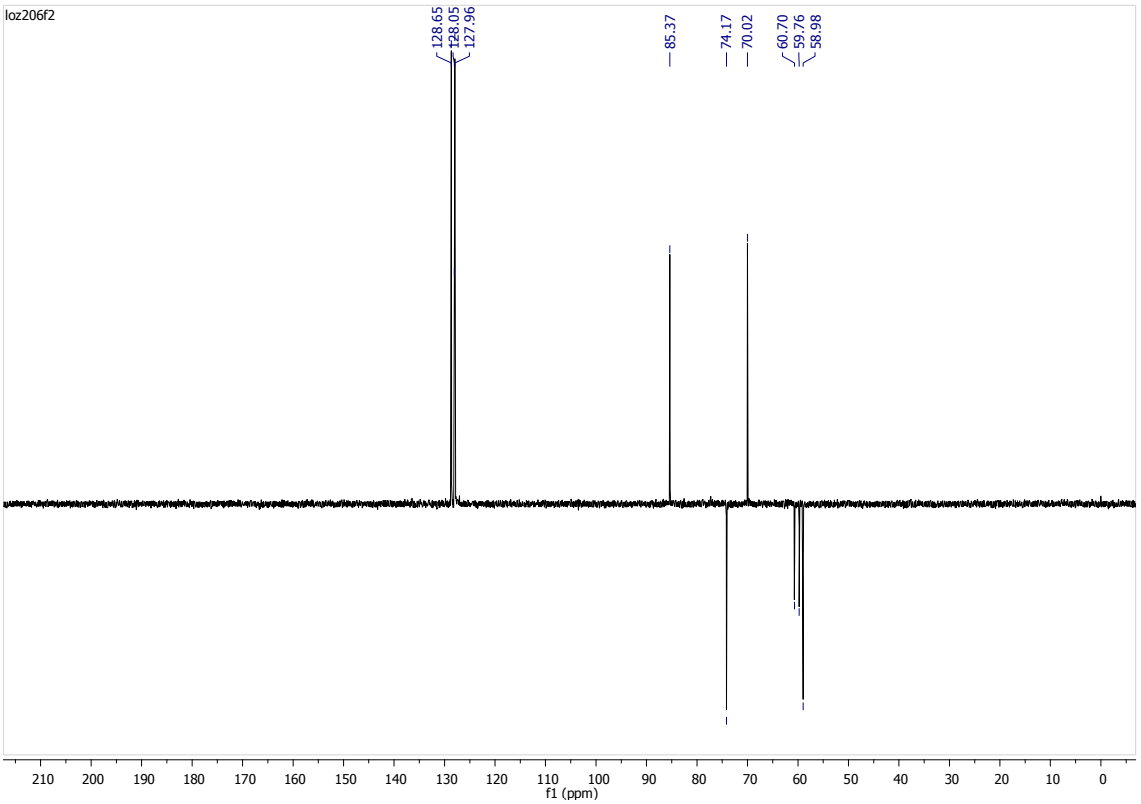
ESI HRMS: $[M+H]^+$ calcd for $C_{22}H_{30}NO_5$ 388.2119; found 388.2120

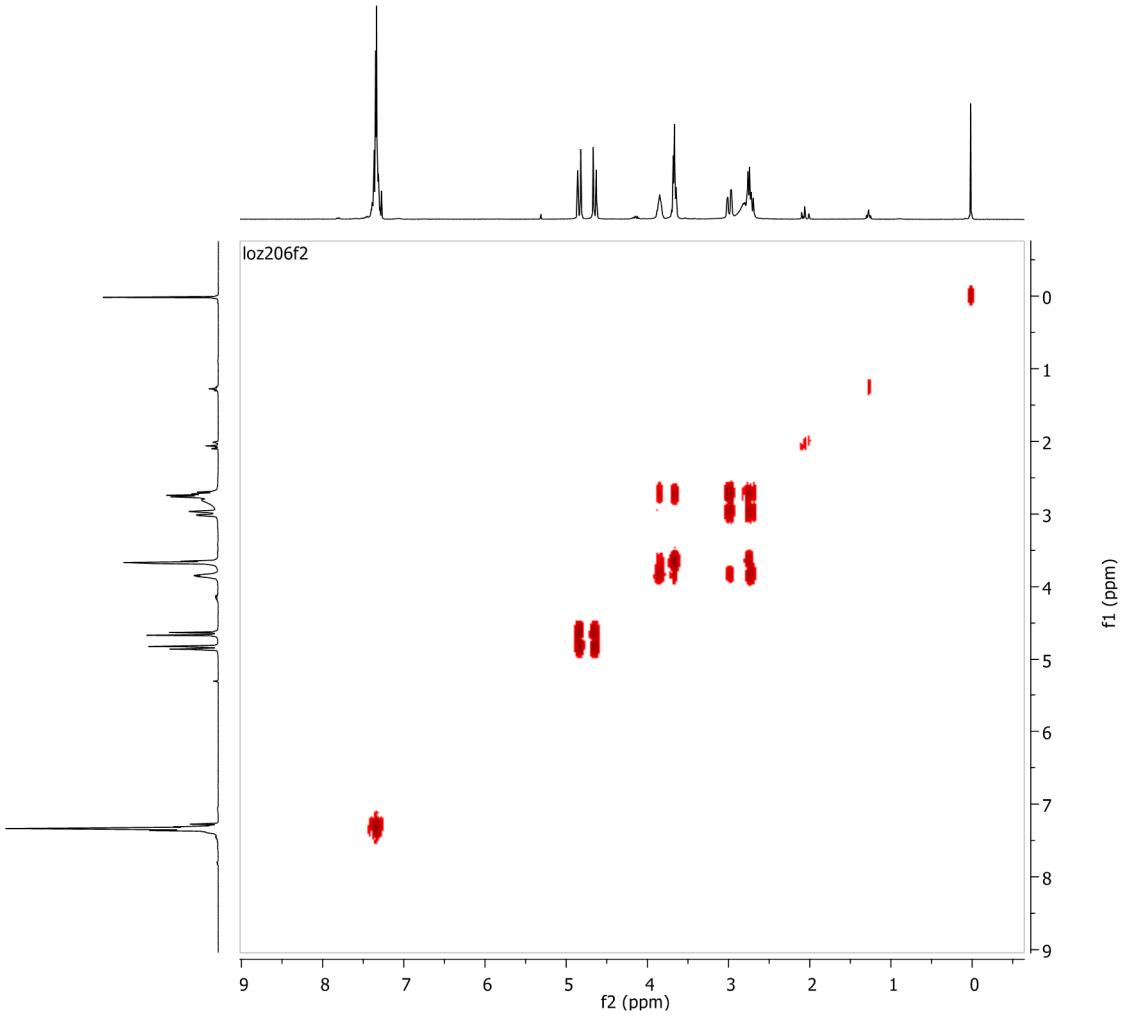
_N_-Hydroxyethyl-2,3,4,6-tetra-_O_-acetyl-1,6-dideoxy-1,6-imino-L-iditol (38b):

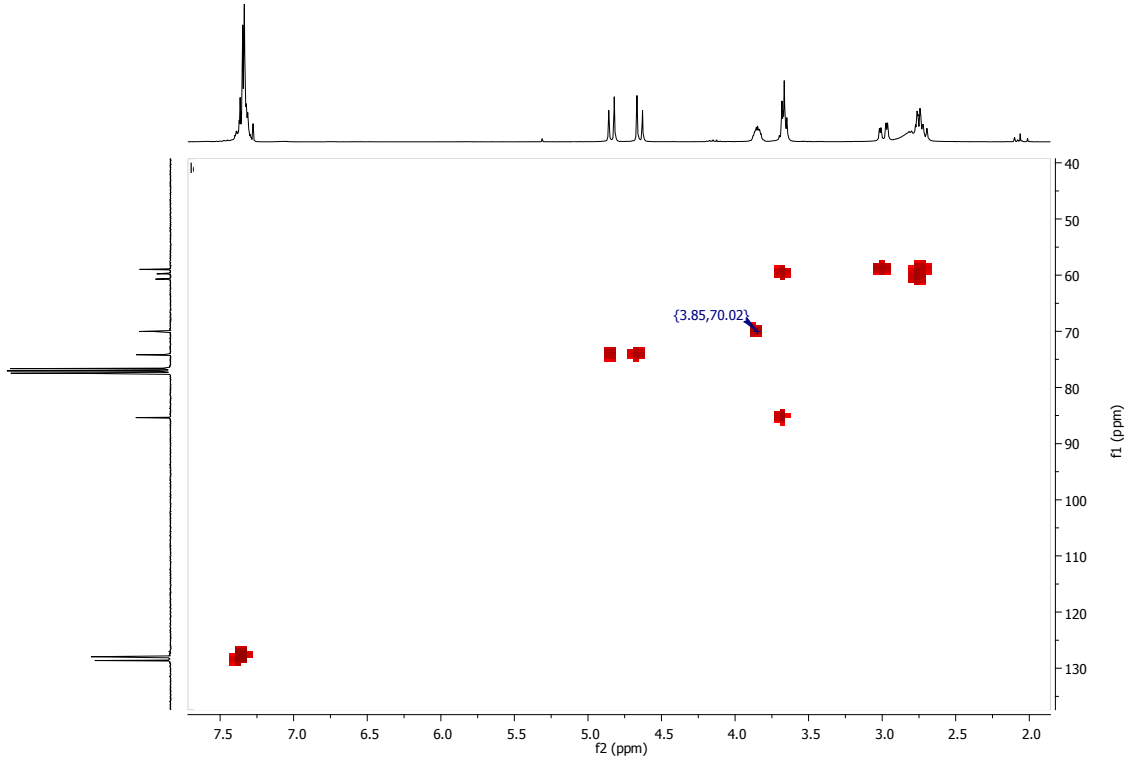


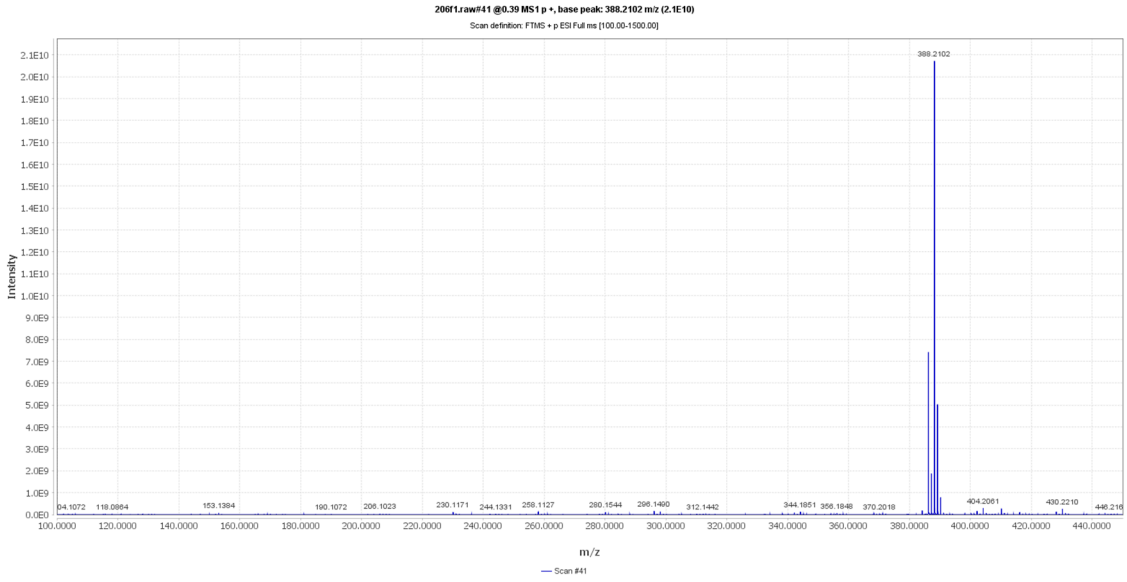





loz206f2
128.65
128.05
127.96
85.37
74.17
70.02
60.70
59.76
58.98
f1 (ppm)

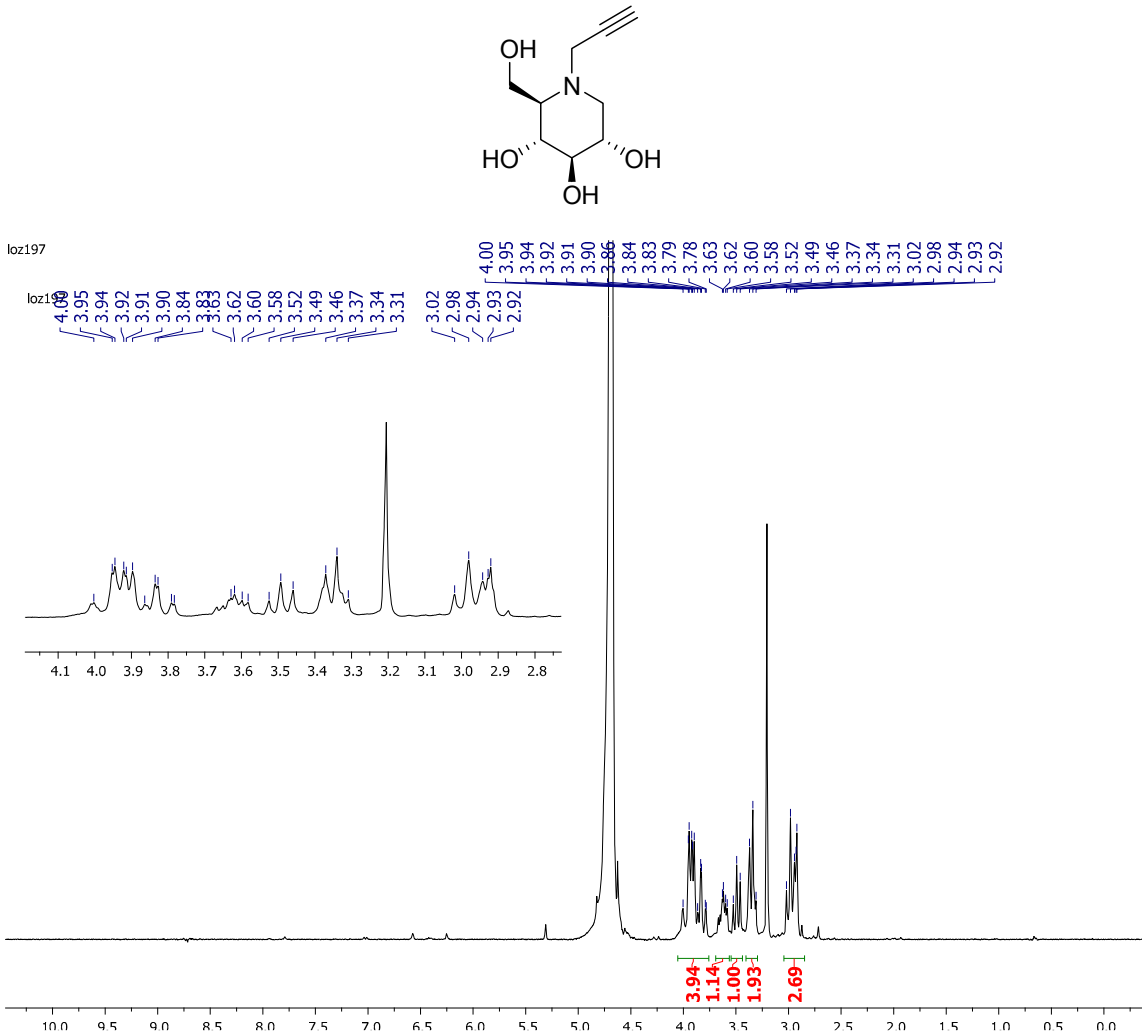

loz206f2
f2 (ppm)
f1 (ppm)



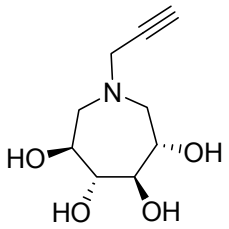


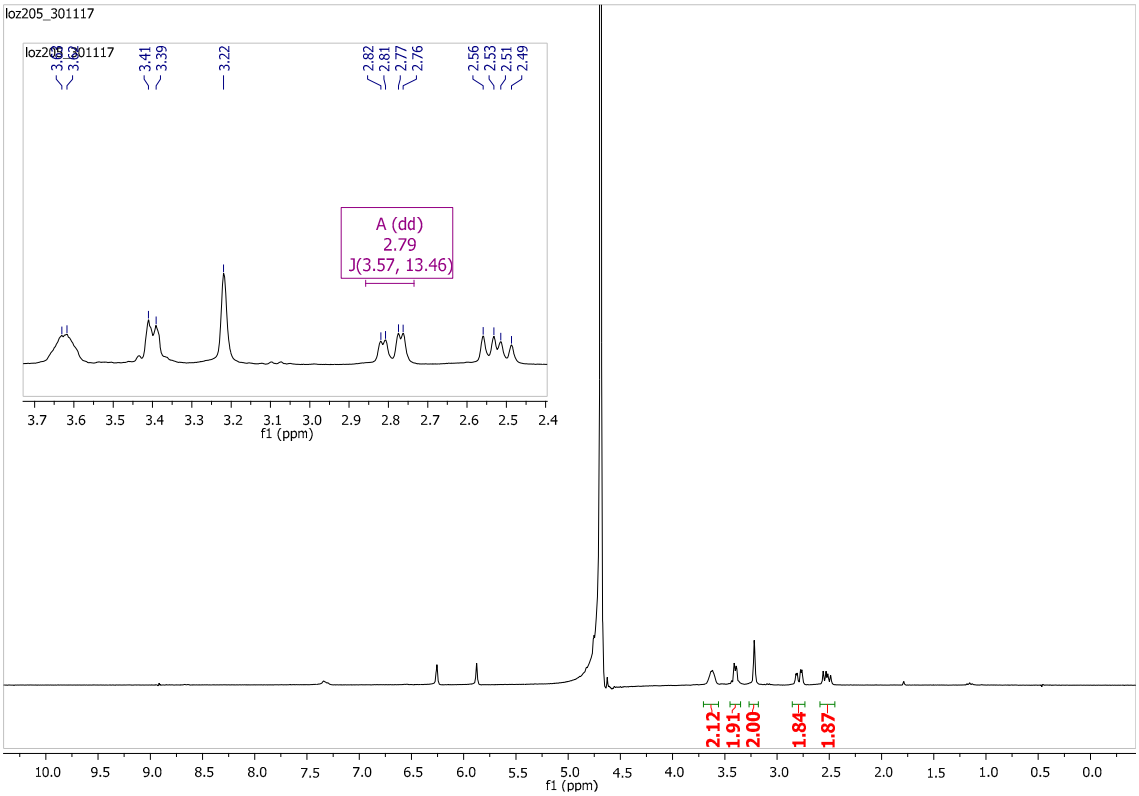
ESI HRMS: $[M+H]^+$ calcd for $C_{22}H_{30}NO_5$ 388.2119; found 388.2102

_N_-Propynyl-1,5-dideoxy-1,5-imino-D-glucitol (39a):

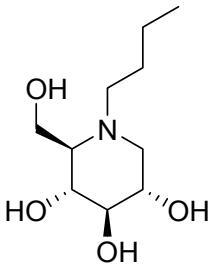


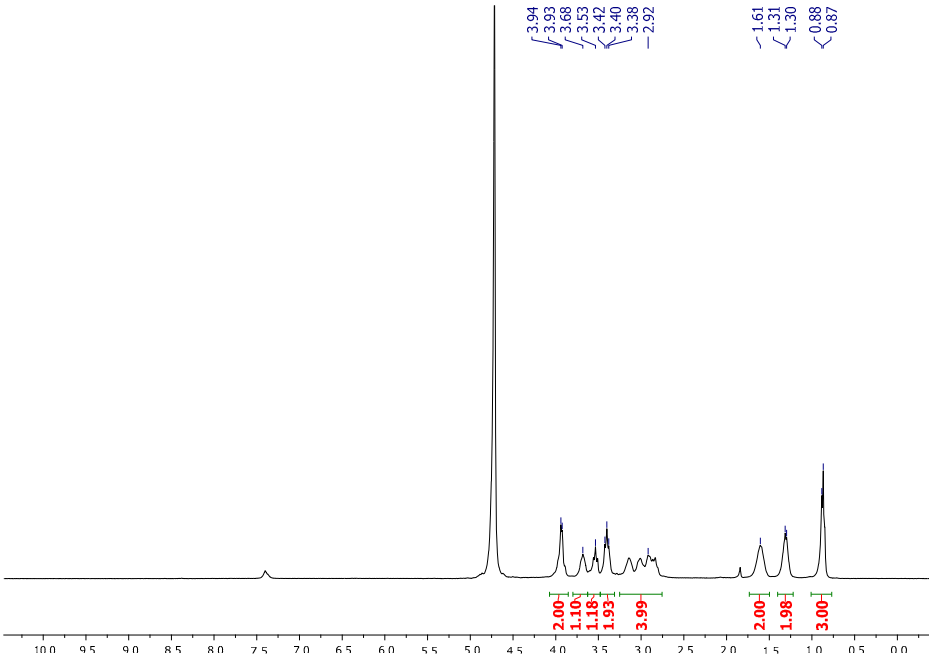
_N_-Propynyl-1,6-dideoxy-1,6-imino-L-iditol (39b):

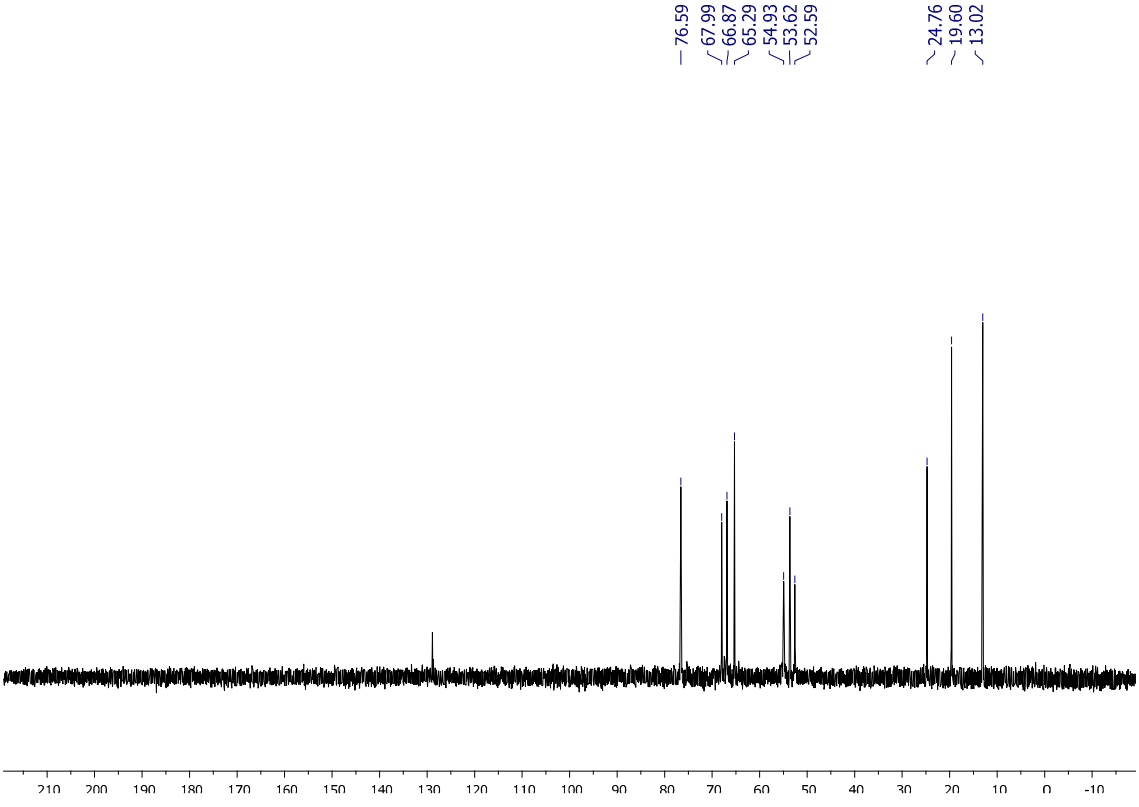


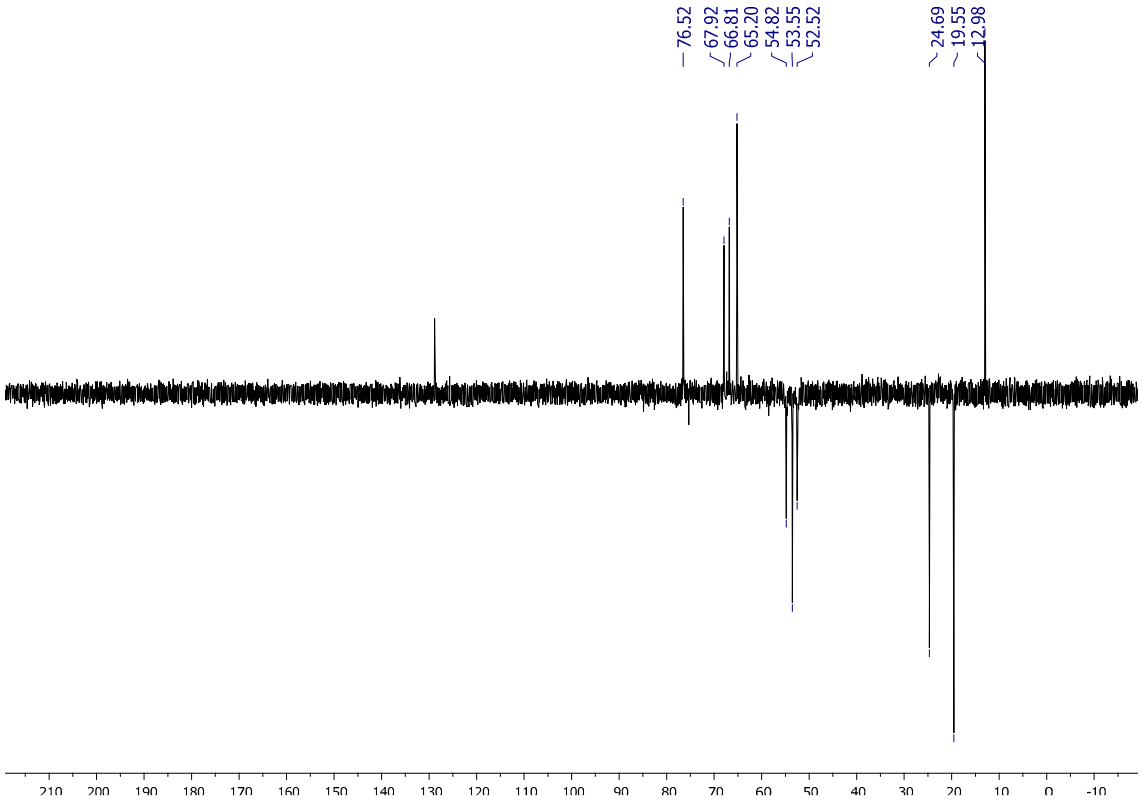


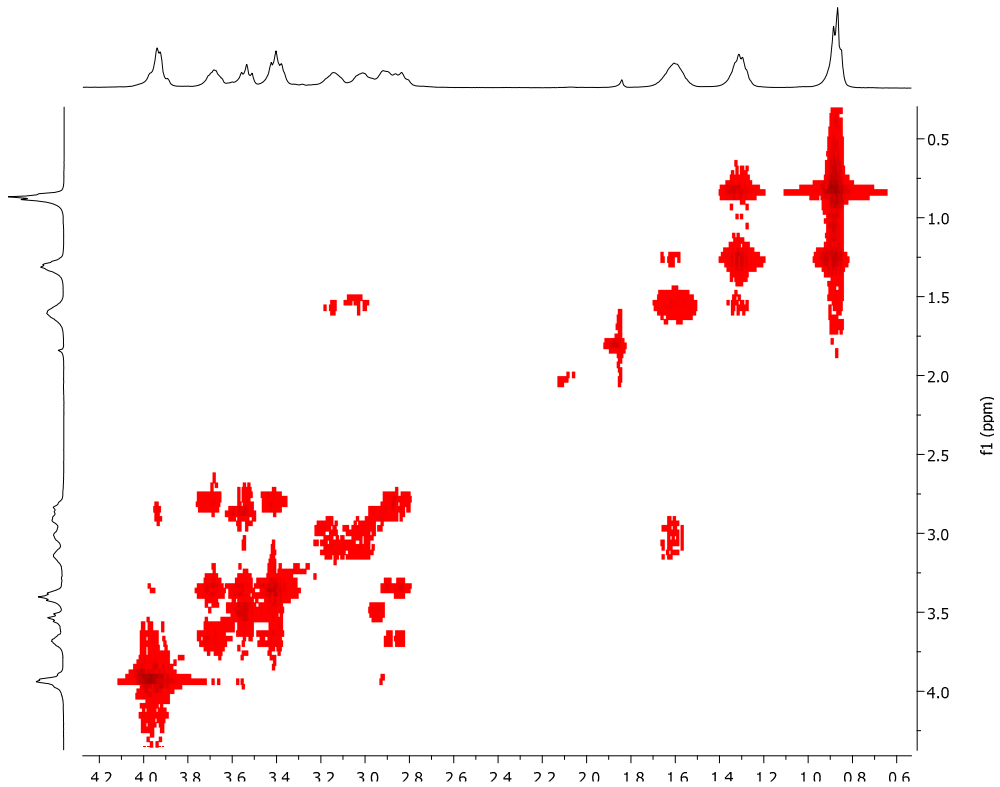
_N_-Butyl-1,5-dideoxy-1,5-imino-D-glucitol (40a):

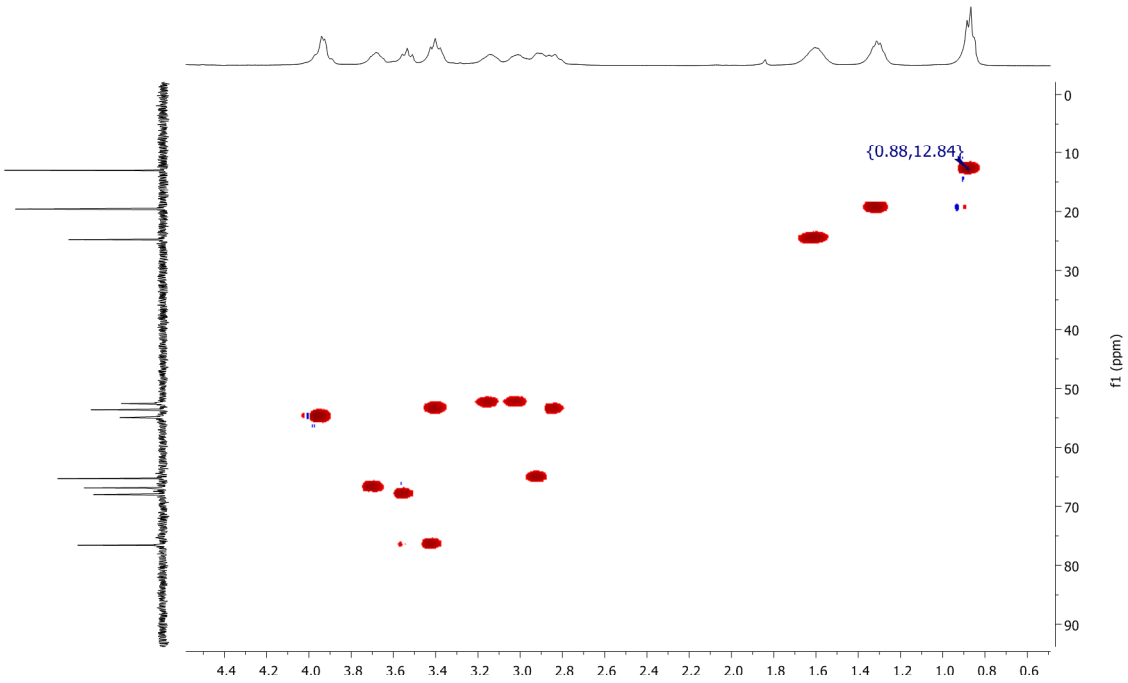




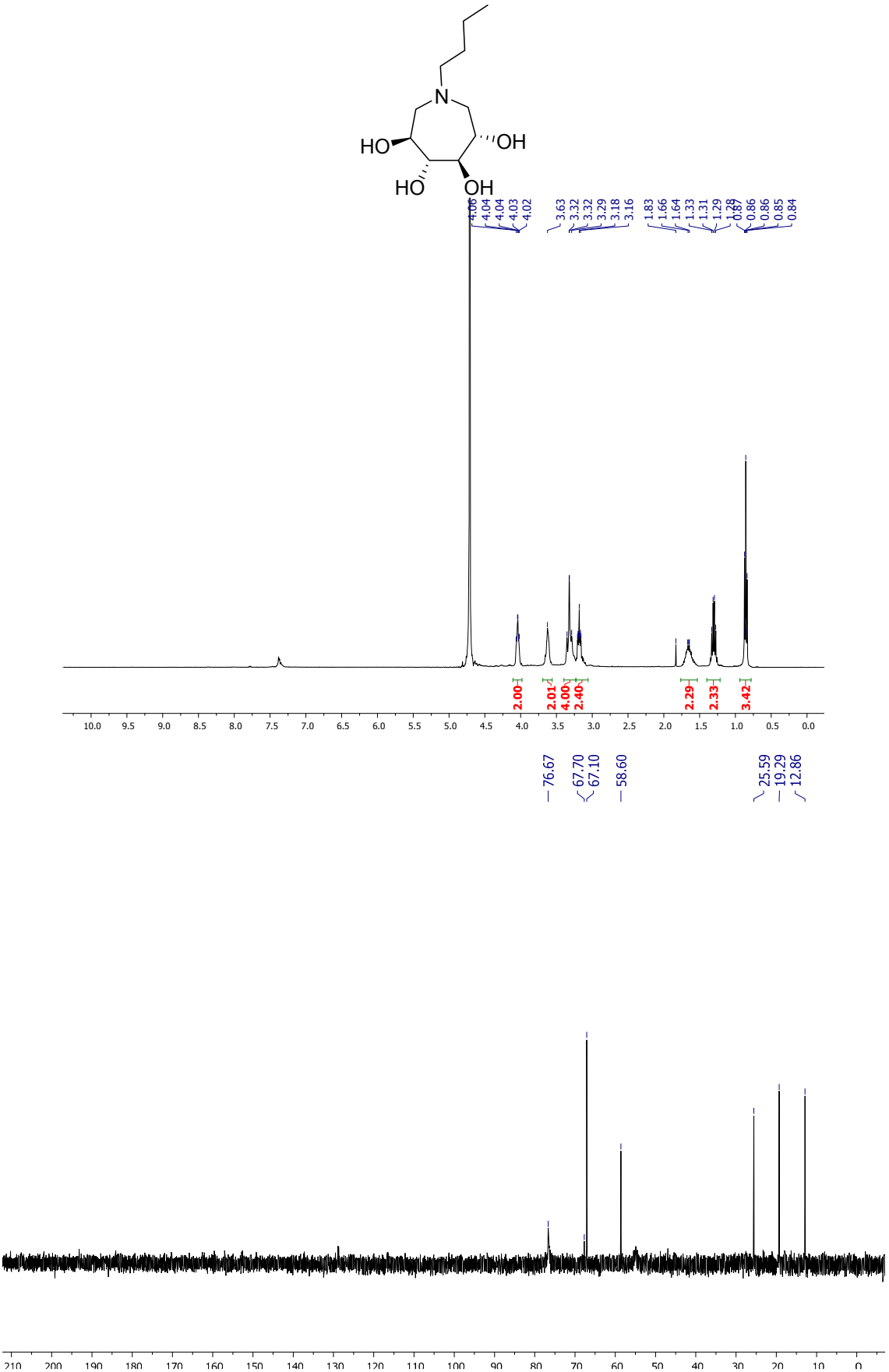


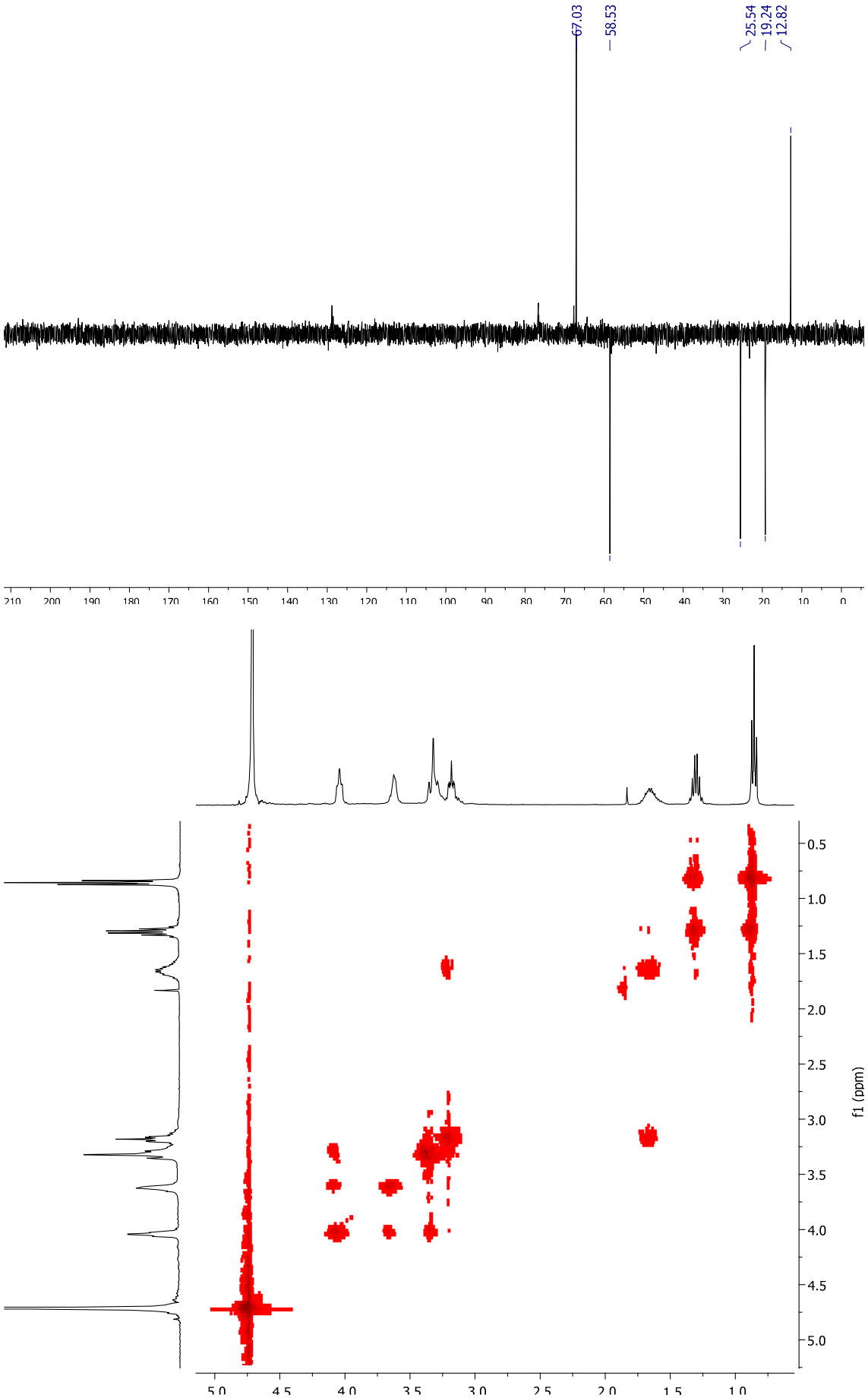

76.52
67.92
66.81
65.20
54.82
53.55
52.52
24.69
19.55
12.98
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10

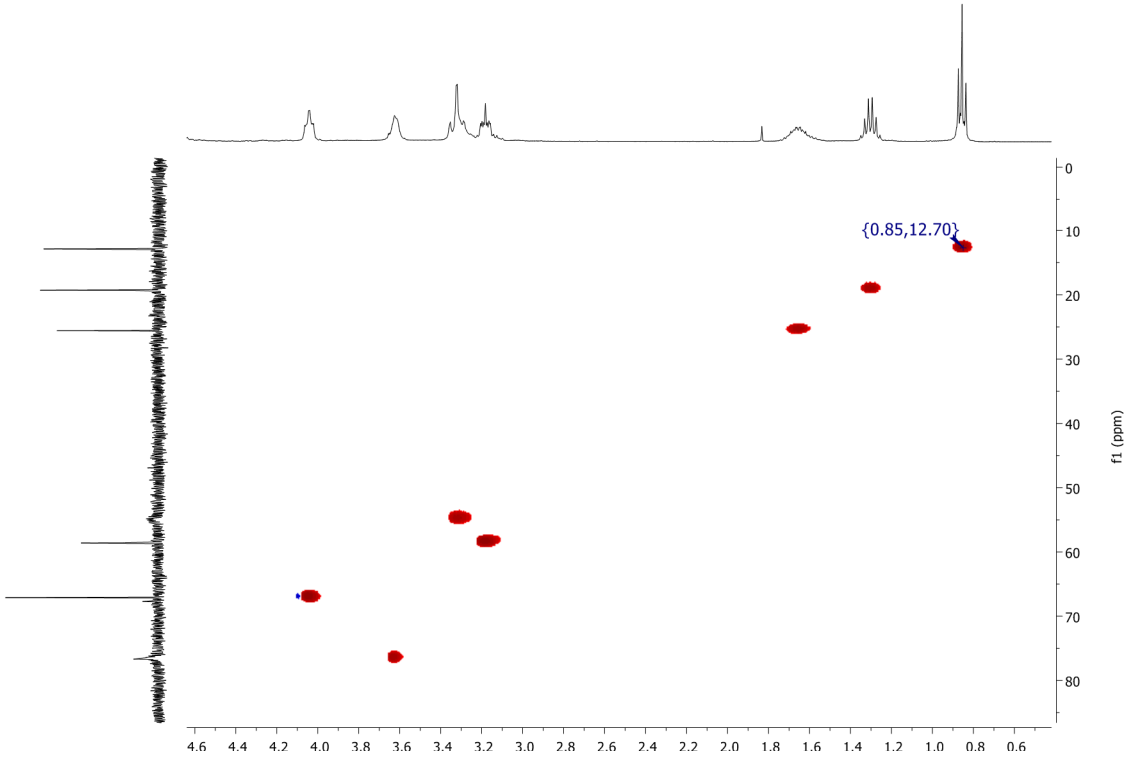

0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
f1 (ppm)
42 40 38 36 34 32 30 28 26 24 22 20 18 16 14 12 10 08 06

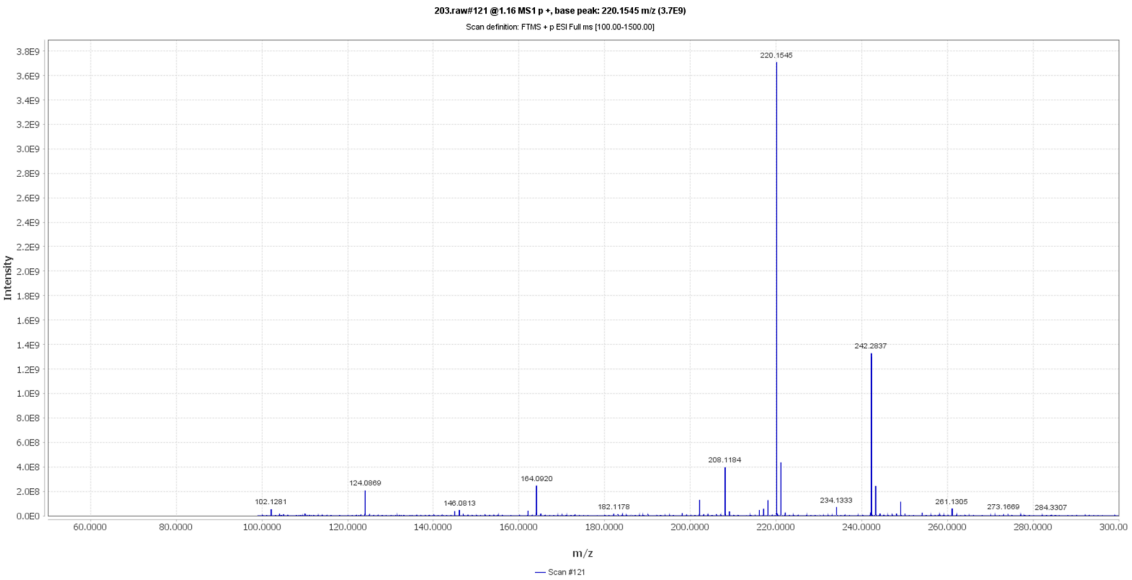

{0.88,12.84}
f1 (ppm)
0
10
20
30
40
50
60
70
80
90
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6

_N_-Butyl-1,6-dideoxy-1,6-imino-L-iditol (40b):



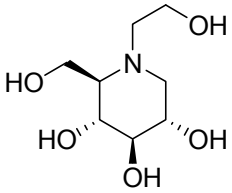

67.03
58.53
25.54
19.24
12.82
f1 (ppm)

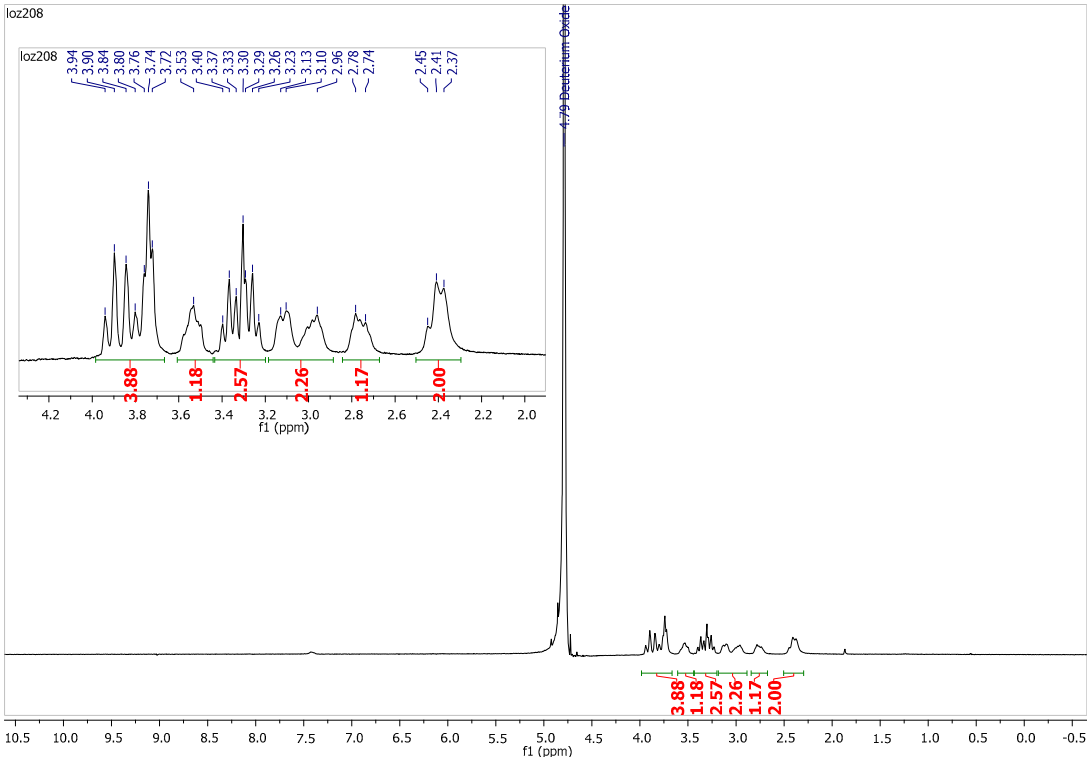


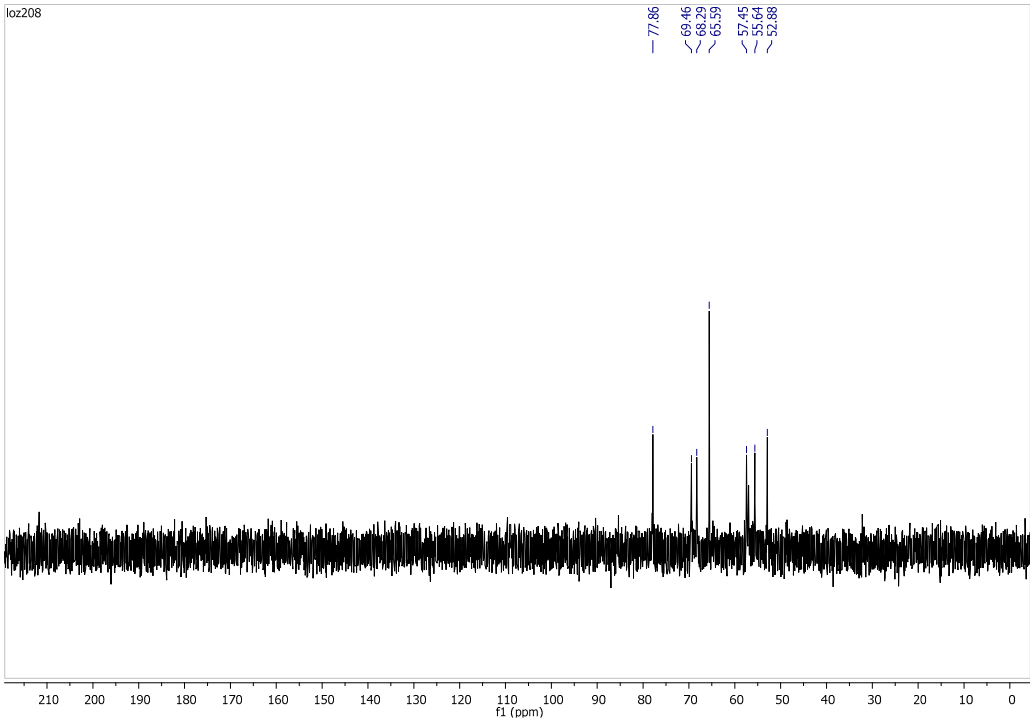


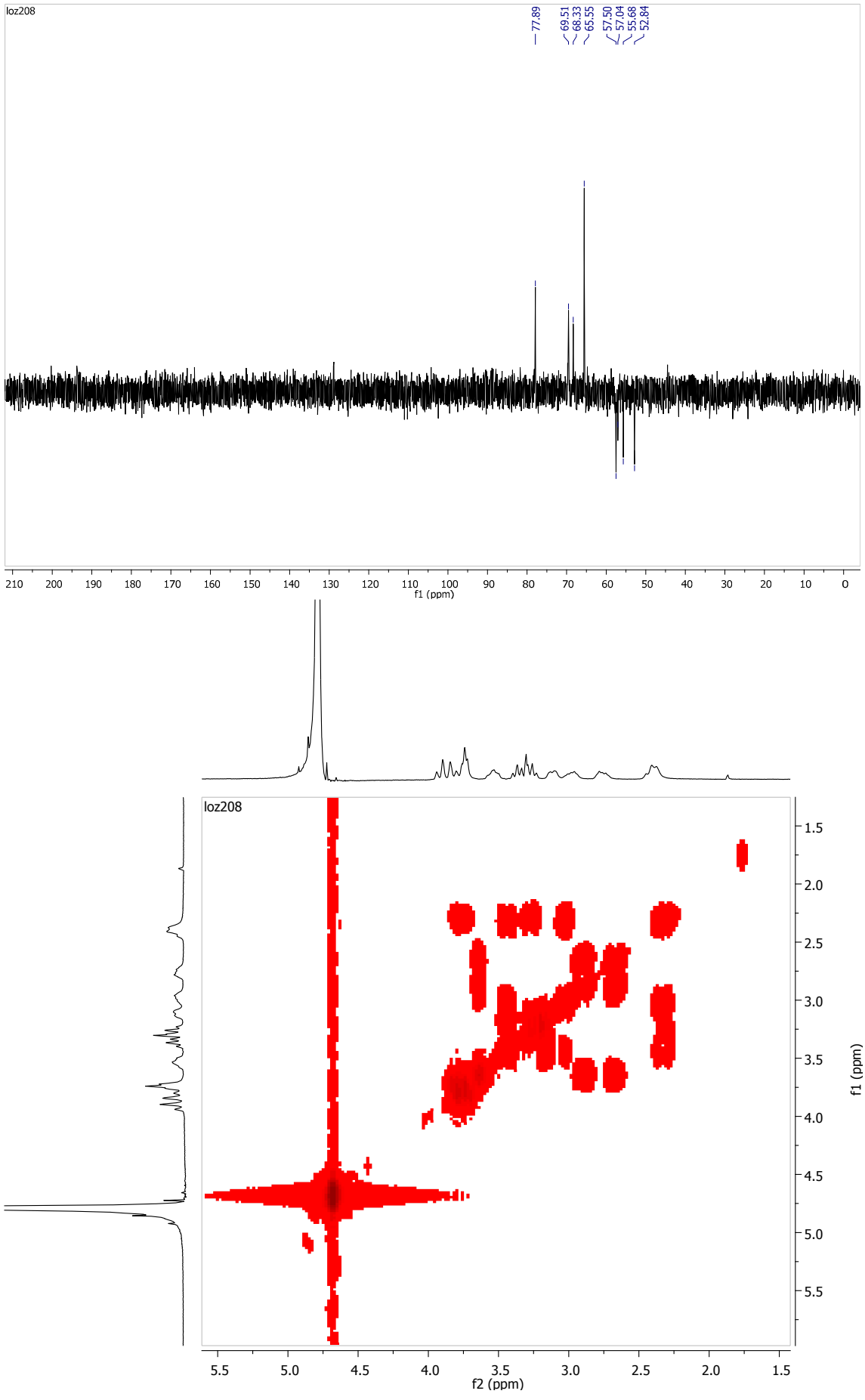
ESI HRMS: $[M+H]^+$ calcd for $C_{10}H_{22}NO_4$ 220.1544; found 220.1545

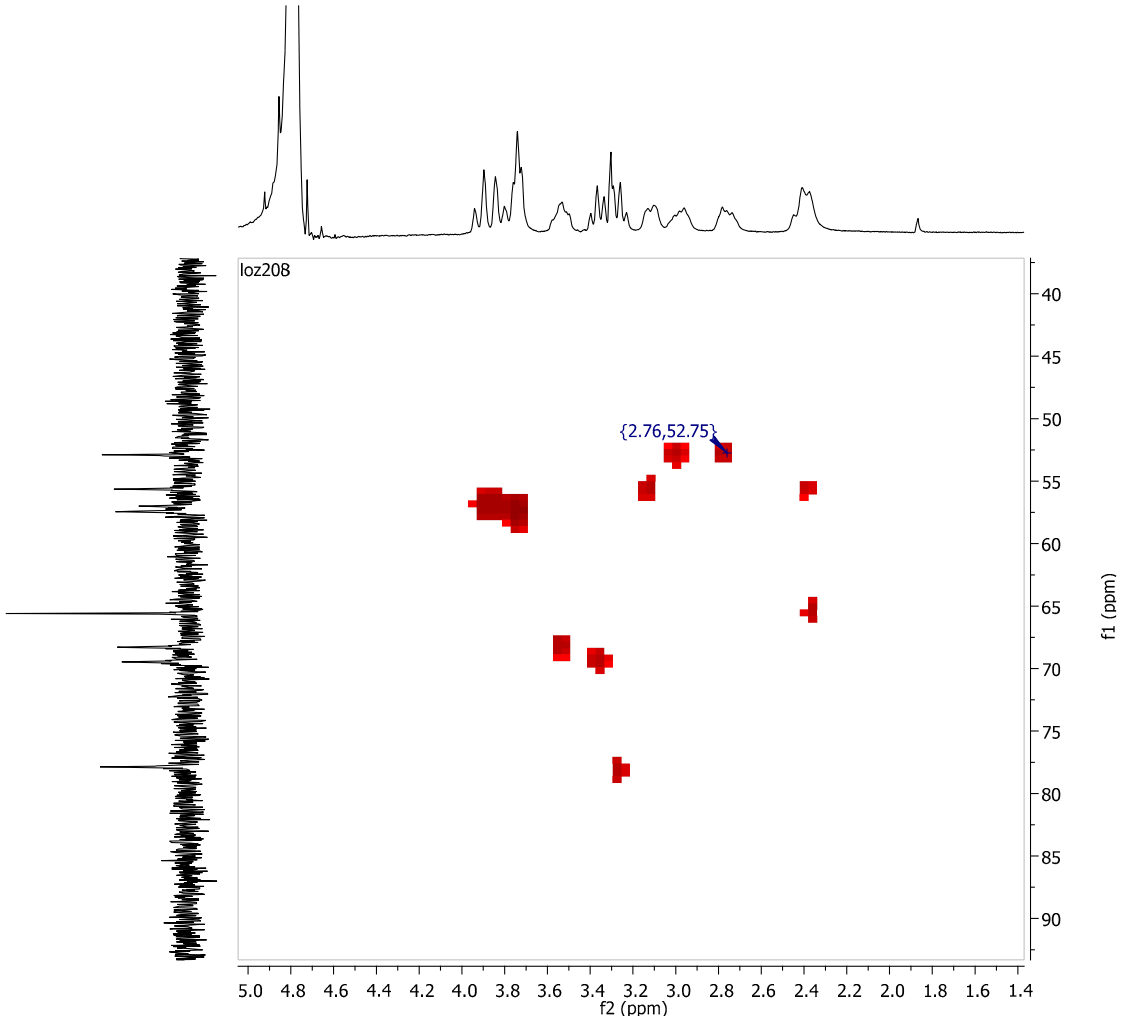
_N_-Hydroxyethyl-1,5-dideoxy-1,5-imino-D-glucitol (41a):



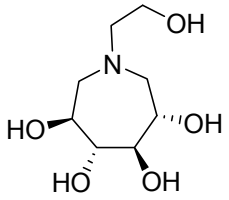


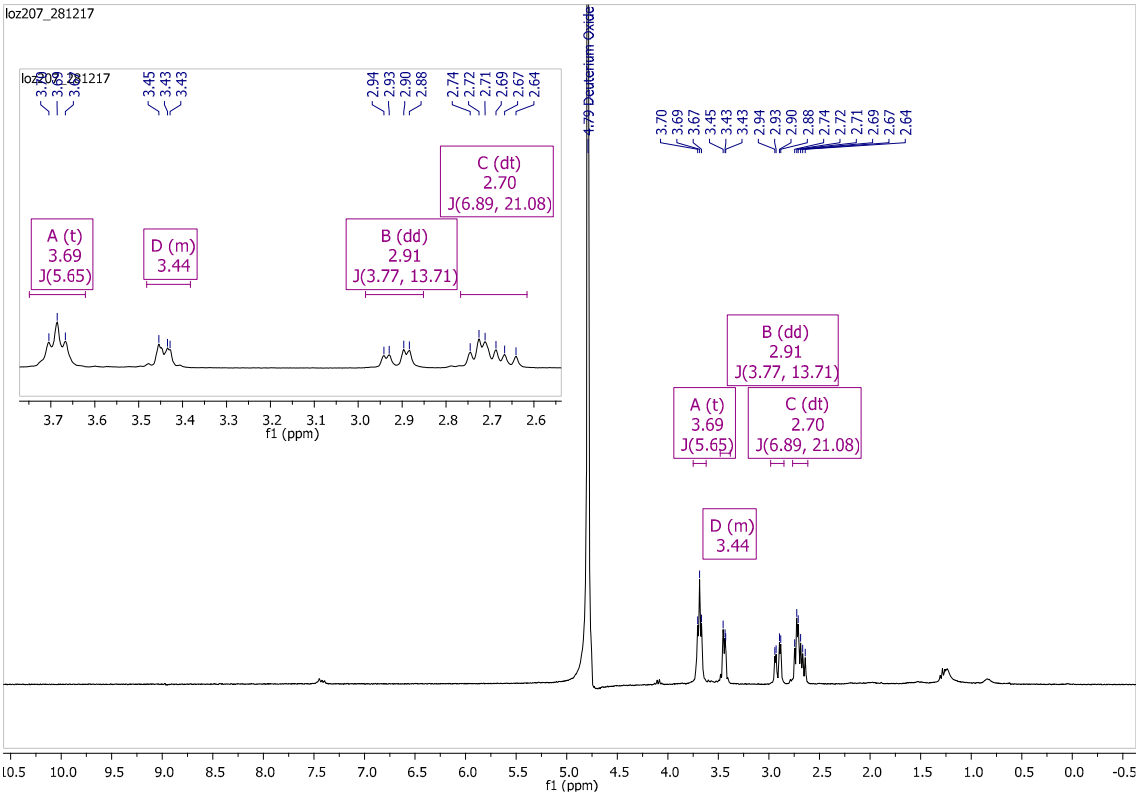


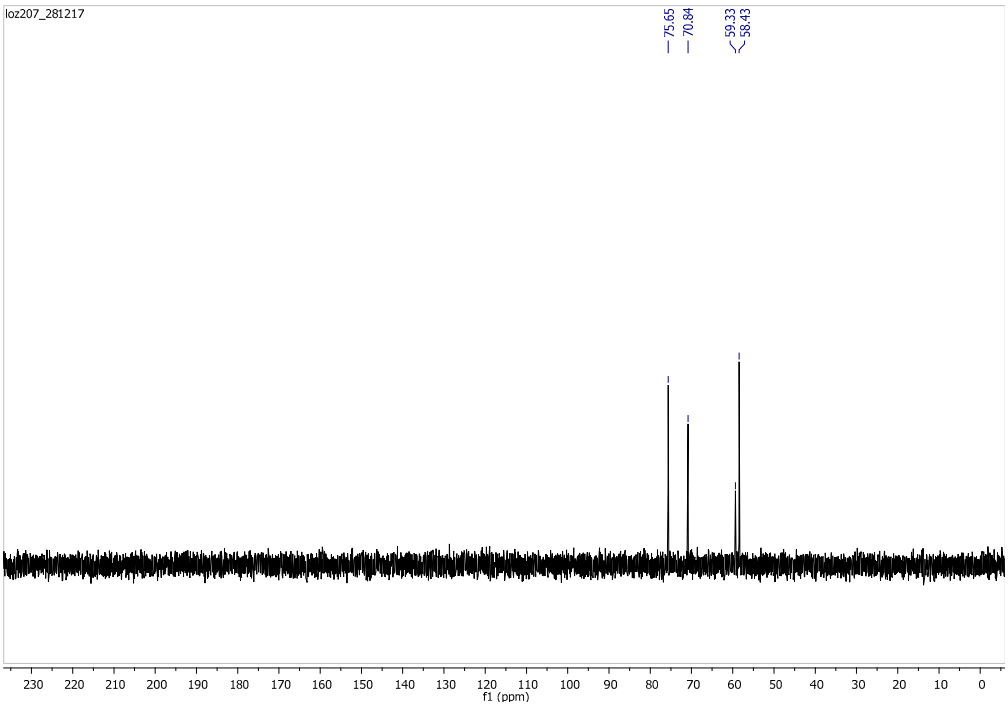

loz208
77.89
69.51
68.33
65.55
57.50
57.04
55.68
52.84
f1 (ppm)
loz208
f2 (ppm)
f1 (ppm)

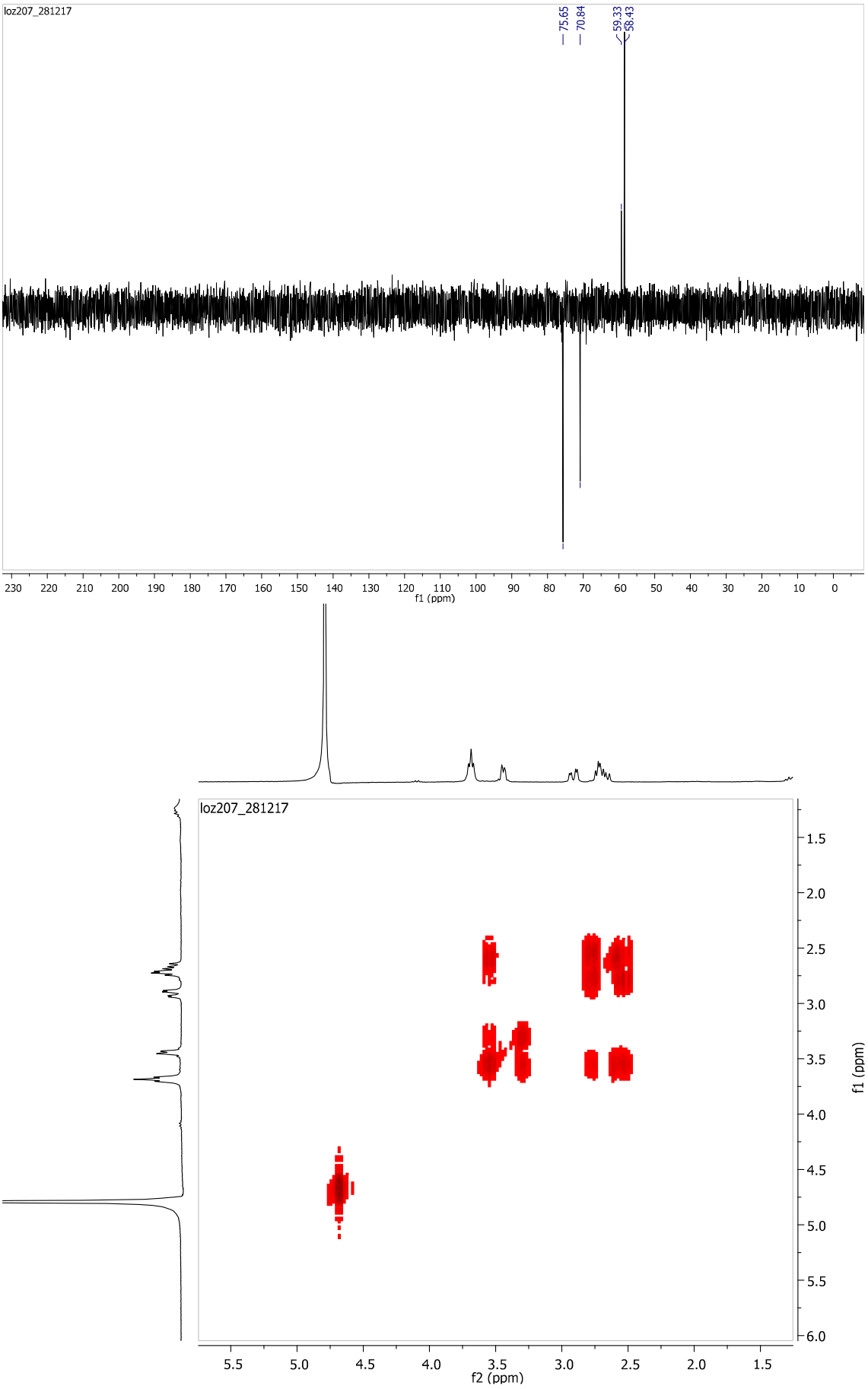

loz208
{2.76,52.75}
40
45
50
55
60
65
70
75
80
85
90
f1 (ppm)
5.0
4.8
4.6
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
f2 (ppm)

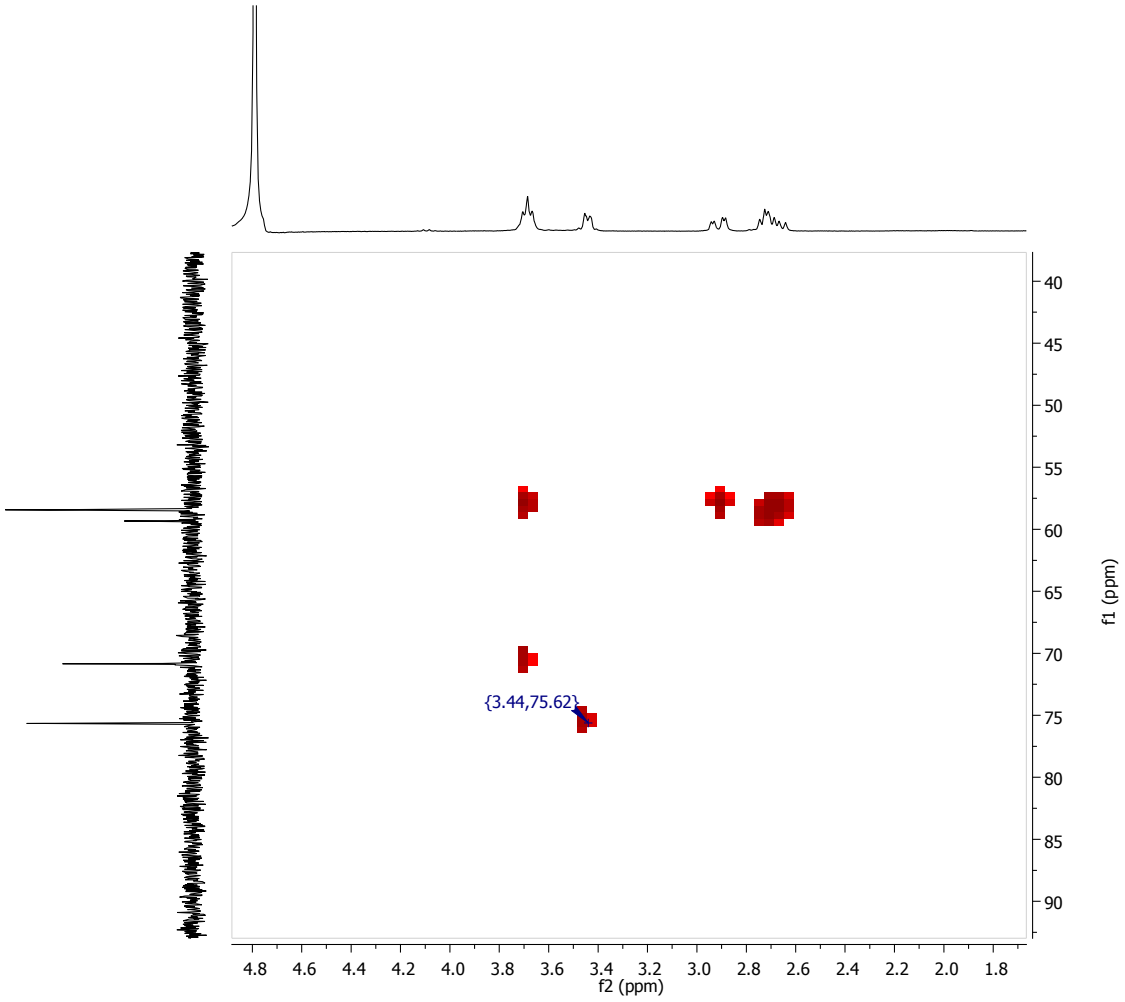
_N_-Hydroxyethyl-1,6-dideoxy-1,6-imino-L-iditol (41b):

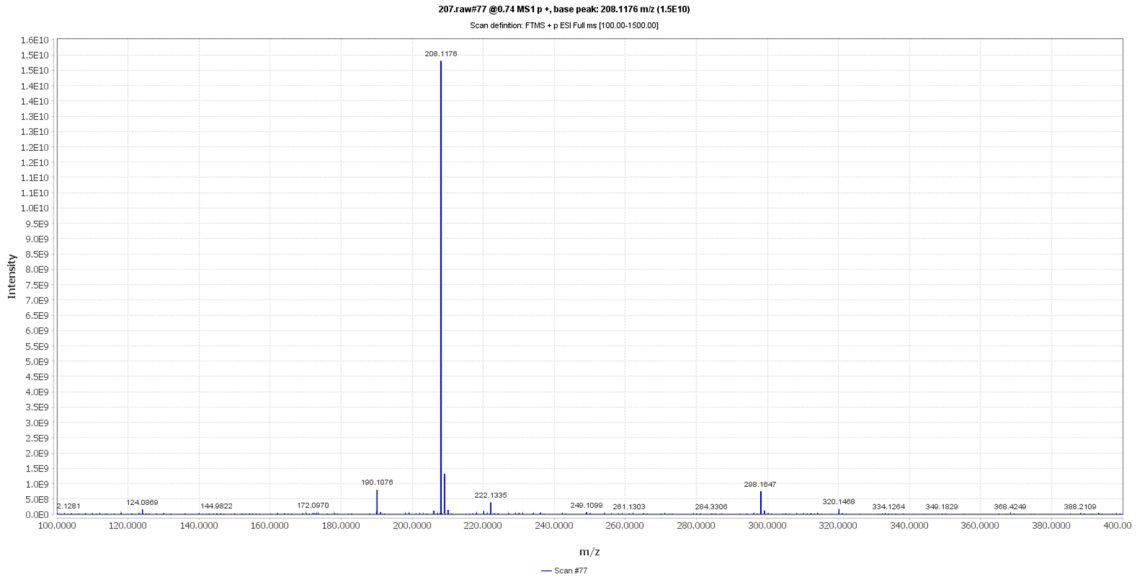




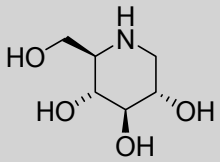
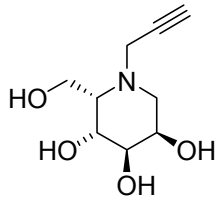
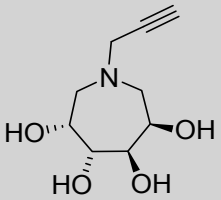
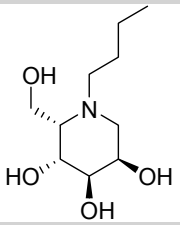
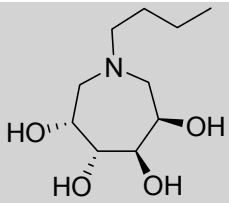
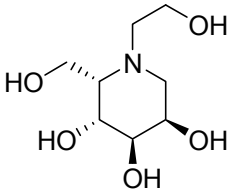
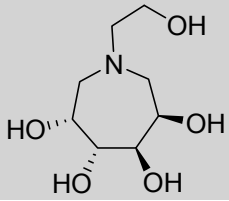
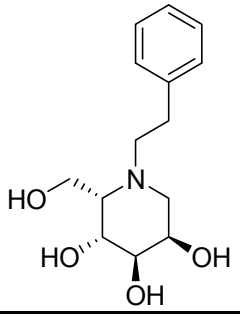


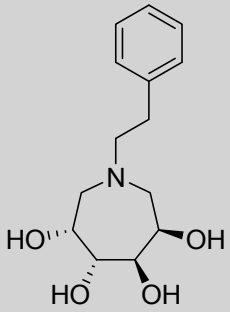
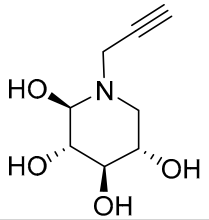
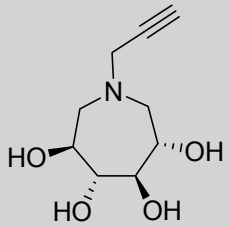
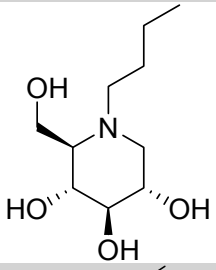
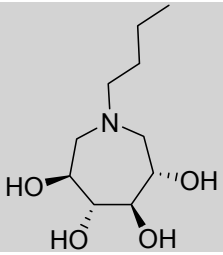
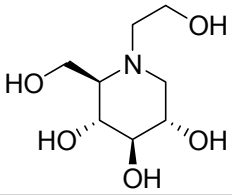
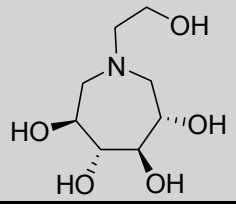

loz207_281217
75.65
70.84
59.33
58.43
230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)
loz207_281217
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
f1 (ppm)
5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5
f2 (ppm)



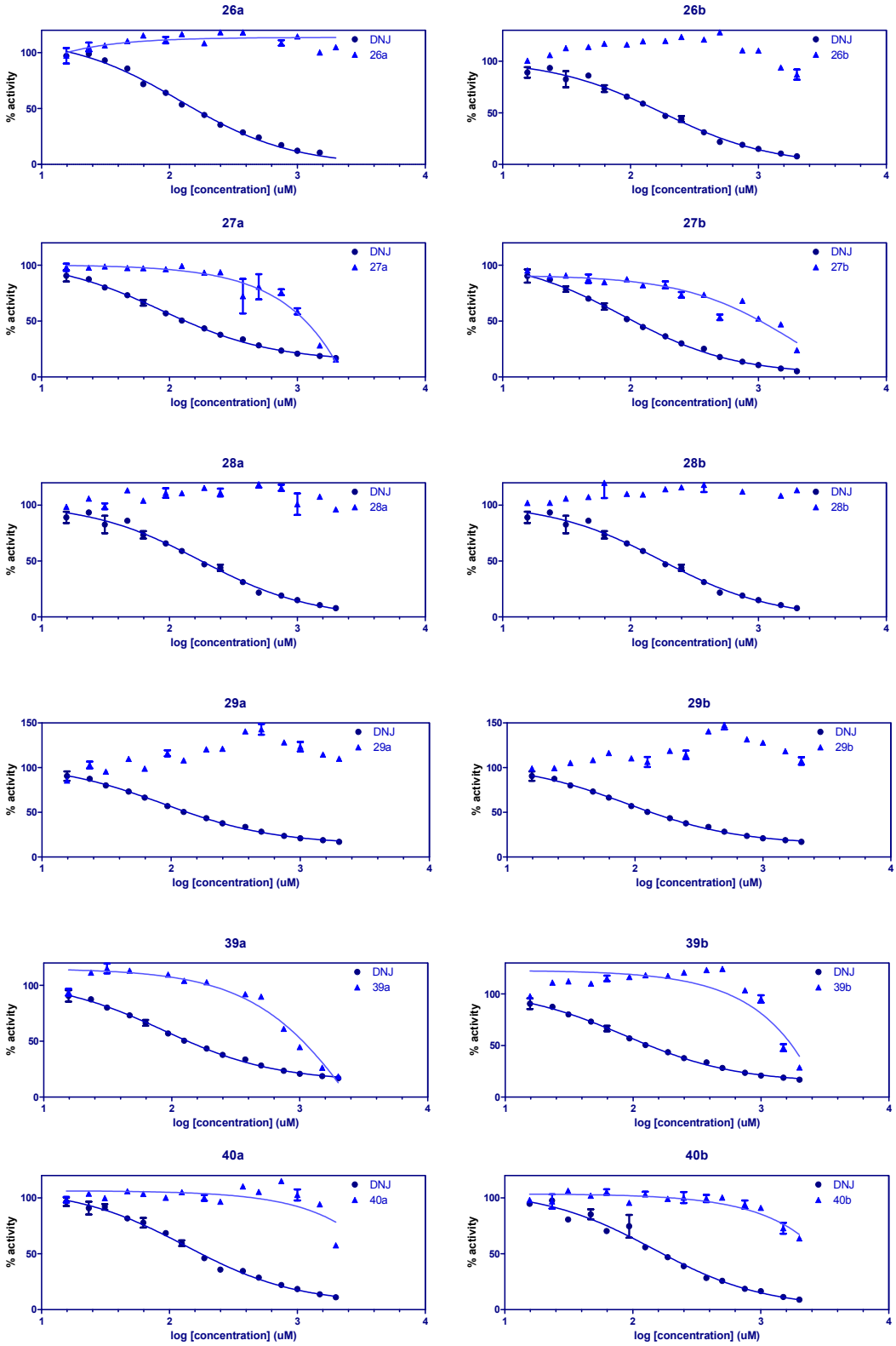


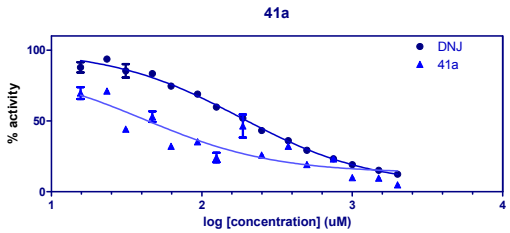
ESI HRMS: $[M+H]^+$ calcd for $C_8H_{18}NO_5$ 208.1180; found 208.1176

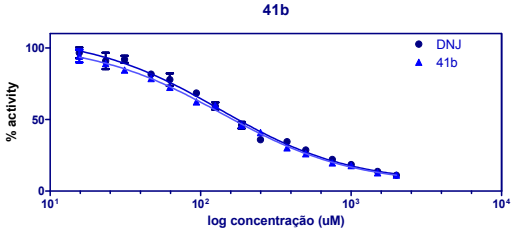
	Structure	*Yeast* α-Glucosidase	*Almond* β-Glucosidase
DNJ		134.4±2.1	33.1±3.1
26a		NI	1716±12.8
26b		NI	NI
27a		NI	109.7±9.3
27b		2031±17.1	184.6±2.6
28a		NI	NI
28b		NI	NI
29a		NI	NI

29b		NI	NI
39a		2527±82.2	635.7±8.5
39b		NI	3437±70.6
40a		NI	172.8±1.7
40b		NI	80.0±4.9
41a		41.3±10.2	4.0±1.5
41b		138.8±1.2	4.1±1.4

α-Glucosidase Yeast

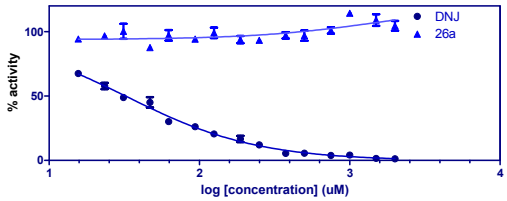



41a
DNJ
41a
% activity
100
50
0
1
2
3
4
log [concentration] (uM)

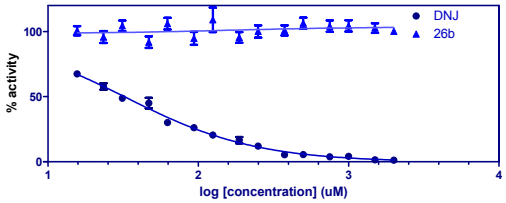

41b
DNJ
41b
% activity
100
50
0
10¹
10²
10³
10⁴
log concentração (uM)

β-Glucosidase Almond

26a



26b



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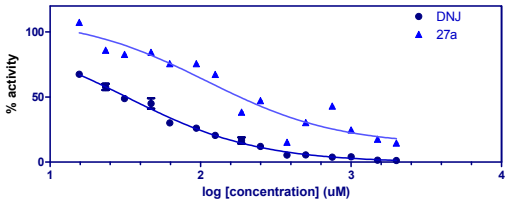

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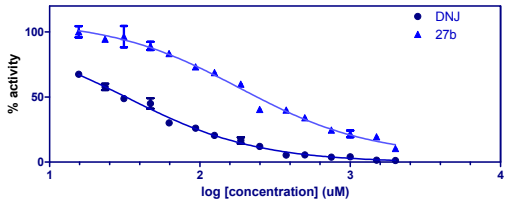

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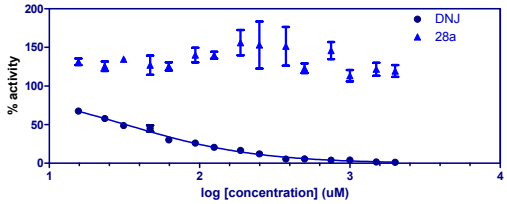

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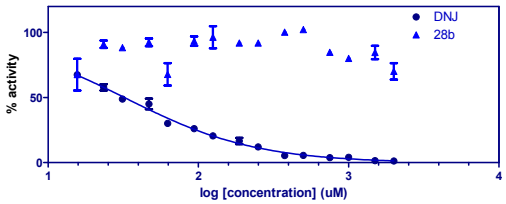

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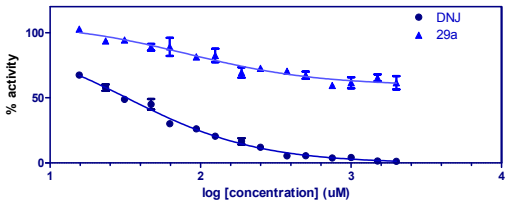

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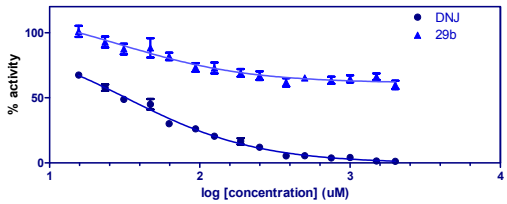

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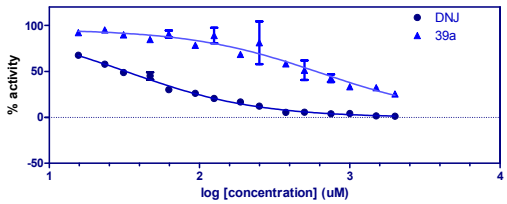

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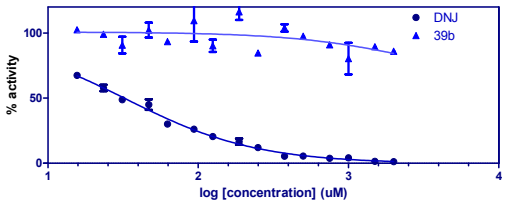

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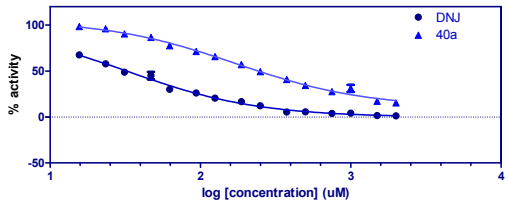

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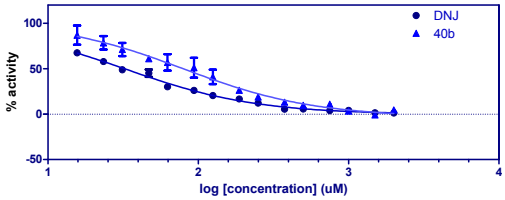

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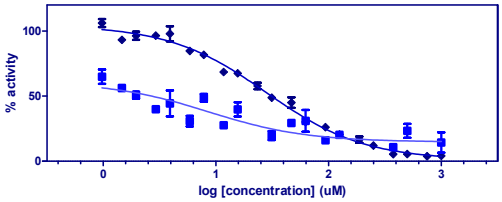

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